

Confined Space Program



OSHAcademy Course 713 Study Guide

Confined Space Program

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This study guide is designed to be reviewed off-line as a tool for preparation to successfully complete OSHAcademy Course 713.

We hope you enjoy the course and if you have any questions, feel free to email or call:

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Contents

Course Introduction	1
Course Goals	1
Module 1: Confined Space Basic Concepts	3
Introduction	3
What is a confined space?	3
What is the difference between these two definitions?	4
Reasons for Entering Confined Spaces	4
Permit-required confined spaces (PRCS)	4
Examples of confined spaces that could become permit spaces	5
Where confined spaces are found	5
<i>What is confined space “entry”?</i>	6
Using alternative entry procedures	6
Flow Chart	8
Module 1 Quiz	9
Module 2: Confined Space Program Elements	11
Introduction	11
Elements of the confined space program	11
Workplace Evaluation Procedures- What is the written plan?	11
Identify Confined Spaces	12
Warning signs	12
Hazard identification procedures	12
Procedures and practices	13
Entry permit system	14

Employee training for authorized entrants, attendants, and entry supervisors.....	14
Controlling confined space hazards.....	14
Equipment and Resources for safe entry	14
A measurement system	15
Confined Space Rescue Plan	15
Annual Program Evaluation	15
Module 2 Quiz.....	16
Module 3: The Confined Space Entry Permit Purpose of Confined Space Entry Permit	18
Sections of the entry permit	18
Permit validity	19
Cancelling entry permits	19
Entry permit maintenance	19
Sample Permit.....	20
Module 3 Quiz.....	21
Module 4: Confined Space Atmospheric Hazards	23
Introduction	23
Confined space hazard categories	23
Hazardous atmospheres	23
Acceptable atmospheric conditions	24
Oxygen deficiency	24
Oxygen enrichment.....	25
Combustible and flammable gases	25
Lower Flammability Limits (LFL) and Lower Explosive Limits (LEL}	26
Upper Explosive Limit (UEL) and Upper Flammability Limit (UFL).....	26

Flammable Range.....	26
Combustible dust atmospheres.....	27
Toxic atmospheres.....	27
Irritant/Corrosive Atmospheres.....	29
Examples of Corrosives	29
The Material Safety Data Sheet (MSDS)	29
Monitoring and testing for hazardous atmospheres.....	30
The "OFT" order of testing in confined spaces	31
Atmosphere Sampling Procedure	31
Direct-reading testing instruments.....	32
Purchasing monitoring equipment	33
What does "immediately dangerous to life or health" (IDLH) mean?.....	33
Permissible Exposure Limits (PELs)	34
Module 4 Quiz.....	35
Module 5: Non-Atmospheric Hazards	37
Types of physical hazards encountered in confined spaces.....	37
Mechanical Hazards	37
Skin Contact Hazards	37
Limited Access Hazards.....	38
Slip and Trip Hazards.....	38
Fall Hazards	39
Personal Fall Protection System	39
Work Environment Temperature Related Hazards	39
Communication Problems	41

Excessive Noise Hazards	41
High-Pressure Hazards	42
Electrical Hazards	43
Vibration	44
Impact Hazards	44
Entrapment hazards.....	45
Engulfment.....	45
General/Physical	45
Module 5 Quiz.....	47
Module 6: Controlling Confined Space Hazards	49
Introduction	49
Hazard Elimination and Substitution	49
Elimination	49
Substitution.....	49
Confined space engineering controls	49
Confined space administrative controls	50
Personal protective equipment (PPE).....	50
Primary control-Toxic Atmospheres	50
Ventilating confined spaces	50
Considerations to ensure proper ventilation	51
Respiratory protection	52
Confined Space Inspections	52
Module 6 Quiz.....	55
Module 7: The Confined Space Entry Team	57

Management responsibilities	57
Confined Space Entry Supervisor responsibilities	57
Confined Space Entrant responsibilities	59
Confined Space Attendant responsibilities.....	59
Confined Space Rescue Team responsibilities?	60
Module 7 Quiz.....	61
Module 8: Confined Space Rescue	63
Introduction	63
Why confined spaces kill so many people	63
Confined space emergencies	63
Preventing confined space rescuer fatalities.....	63
Confined space rescue training topics	64
Three rescue strategies.....	64
Informing rescuers	65
The rescue plan	66
Rescue Simulations	66
Re-evaluating rescue plans	66
Verifying the availability of the off-site rescue service	67
Entry vs. Non-Entry	68
Rescue equipment	68
Using the full body harness and retrieval lines.....	68
Module 8 Quiz.....	70
Module 9: Confined Space Training Requirements	72
Introduction	72

Confined space training triggers	72
General Training Topics	72
Specific Training	73
Training for Attendants	73
Training for Emergency Response Personnel	74
Verification of Training	74
Module 9 Quiz	75

Course Introduction

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

- Workers haven't been properly trained to recognize permit-space hazards.
- Hazards aren't eliminated or controlled before workers enter the space.
- Rescuers are inexperienced or improperly trained.


Course Goals

This course has been developed to explain the hazards of confined space work and to assist employers in establishing and maintaining an effective confined space program. By implementing such a program, your employees will be able to:

- Recognize, evaluate, and control confined space hazards.
- Save lives and protect employees from job-related injuries and illnesses.
- Promote safe and effective work practices.
- Reduce preventable workers' compensation costs
- Comply with company procedures and practices

This course provides a general overview of a particular topic related to OSHA standards. It does not alter or determine compliance responsibilities in OSHA standards or the Occupational Safety and Health Act of 1970. Because interpretations and enforcement policy may change over time, you should consult current OSHA administrative interpretations and decisions by the

Occupational Safety and Health Review Commission and the Courts for additional guidance on OSHA compliance requirements.



Protect Yourself Permit-Required Confined Spaces

A confined space has limited openings for entry or exit, is large enough for entering and working, and is not designed for continuous worker occupancy. Confined spaces include underground vaults, tanks, storage bins, manholes, pits, silos, underground utility vaults and pipelines.


Permit-required confined spaces are confined spaces that:

- May contain a hazardous or potentially hazardous atmosphere.
- May contain a material which can engulf an entrant.
- May contain walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant.
- May contain other serious physical hazards such as unguarded machines or exposed live wires.
- Must be identified by the employer who must inform exposed employees of the existence and location of such spaces and their hazards.

What to Do

- Do not enter permit-required confined spaces without being trained and without having a permit to enter.
- Review, understand and follow employer's procedures before entering permit-required confined spaces and know how and when to exit.
- Before entry, identify any physical hazards.
- Before and during entry, test and monitor for oxygen content, flammability, toxicity or explosive hazards as necessary.
- Use employer's fall protection, rescue, air monitoring, ventilation, lighting and communication equipment according to entry procedures.
- Maintain contact at all times with a trained attendant either visually, via phone, or by two-way radio. This monitoring system enables the attendant and entry supervisor to order you to evacuate and to alert appropriately trained rescue personnel to rescue entrants when needed.

For more complete information:



Occupational
Safety and Health
Administration
U.S. Department of Labor
www.osha.gov (800) 321-OSHA

OSHA 1214-08V-05

Module 1: Confined Space Basic Concepts

Introduction

In order to fully understand the information offered in this course, you must first understand the terms used. So, let's take a look at some important definitions for common confined space terms used by most industries and regulatory agencies.

What is a confined space?

That depends on where you're working.

In the United States, a confined space is defined by OSHA as a space that meets all of the following three criteria:

1. The space is large enough and configured such that an employee can bodily enter and perform work;
2. The space has limited means of entry (access) and exit (egress), which means you need to use your hands or contort your body to enter the space; and
3. The space is not designed for continuous employee occupancy.

In Canada, each province may have their own definition of a "confined space," and each of these definitions may be slightly different from OSHA's definition in the U.S. Generally, regulatory agencies in Canada define a confine as having the following three characteristics:

1. It is a fully or partially enclosed space, and
2. It is not both designed and constructed for continuous human occupancy, and
3. It is a space in which atmospheric hazards may occur because of its construction, location or contents or because of work that is done in it.



What is the difference between these two definitions?

- In the United States, a confined space must be large enough for bodily entry. In Canada, the size of the space doesn't matter. Therefore we may assume it must be large enough for part of the body, like the head, to enter. Actually workers have been killed in confined space after only sticking their heads through a hatch or lid. Workers have also been killed in rather shallow trenches. To have a fatal confined space accident, all it takes is a trench or ditch a couple of feet (or a meter) in depth, and a heavier-than-air hazardous atmosphere.
- To be considered a confined space in the United States, the space must have limited access or egress. There is no such requirement in Canada. Examples of limited access are hatches or covers.
- In both the U.S. and Canada, a confined space must not be designed for human/employee occupancy.
- And finally, in Canada the space must have the potential for developing a hazardous atmosphere. In the United States, this requirement is not included in the definition.

In this course, we will focus on confined space entry as defined by OSHA in the USA.

Reasons for Entering Confined Spaces

Entering a confined space may be done for various reasons. It is done usually to perform a necessary function, such as inspection, repair, maintenance (cleaning or painting), or similar operations which would be an infrequent or irregular function of the total industrial activity.

Entry may also be made during new construction. One of the most difficult confined space entries to control is that of unauthorized entry, especially when there are large numbers of workers and trades involved, such as welders, painters, electricians, and safety monitors.

A final and most important reason for entry would be emergency rescue. This, and all other reasons for entry, must be well planned before initial entry is made and the hazards must be thoroughly reviewed.

Permit-required confined spaces (PRCS)

By definition, a permit-required confined space is a space that meets the criteria for a confined space and has one or more of these characteristics:

1. Contains or has the potential to contain a hazardous atmosphere; or

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

See the Confined Space Entry Decision Flow Chart to help you determine if your confined spaces need a permit.

Examples of confined spaces that could become permit spaces

Most confined spaces are designed to hold substances such as liquids, gases, and loose materials, or to house equipment. They come in many sizes and shapes, though most can be classified in one of two ways: those with depth and open tops and those with narrow openings. These are examples of each:

- | | |
|--|--------------|
| • Open-topped areas with deep spaces and narrow openings | • Pits |
| • Ship compartments | • Wells |
| • Silos | • Vats |
| • Pipes | • Hoppers |
| • Tunnels | • Bins |
| • Tanks | • Degreasers |
| • Casings | • Kettles |
| • Sewers | |

Where confined spaces are found

Confined spaces are found not only in industrial settings but also in public places such as shopping malls and large public swimming pools. Waterfalls and water fountain displays used in malls for beautification may have pump vaults or valve pits that are seldom entered. Some swimming pool pumps are placed in vaults below ground. There have been reports of maintenance employees entering these areas and losing consciousness.

Take a look at this discussion that includes examples of where confined spaces are found in construction...

Why confined spaces are hazardous to entrants

By nature, confined spaces can be hazardous due to:

- Space configurations such as small openings and inwardly converging walls, which can trap an entrant, restrict easy entry and exit, or impede rescue.
- Atmospheric hazards such as gasoline tank vapors, combined with limited ventilation. Such conditions can cause asphyxiation or explosion.
- Physical hazards, such as unstable grain contained in silos, which can engulf a worker.
- All other serious hazards associated with general industry, such as electrical equipment, moving machinery, falling objects, and wet or slippery surfaces.

Below is a list of potential hazards.

- No ventilation (pits and vaults seldom opened).
- Leaking chlorine gas (which is heavier than air) can accumulate in low-lying spaces.
- Oxygen depletion can be caused by:
 - Rotting vegetation and decaying dead animals.
 - Corroding or rusting machinery.

Read these actual confined space accident summaries to learn more about the dangers of confined spaces.

What is confined space "entry"?

A confined space entry is considered to have occurred when any part of a person's body crosses the plane of an opening into the space. Each employer should ask these two questions at the onset of each project:

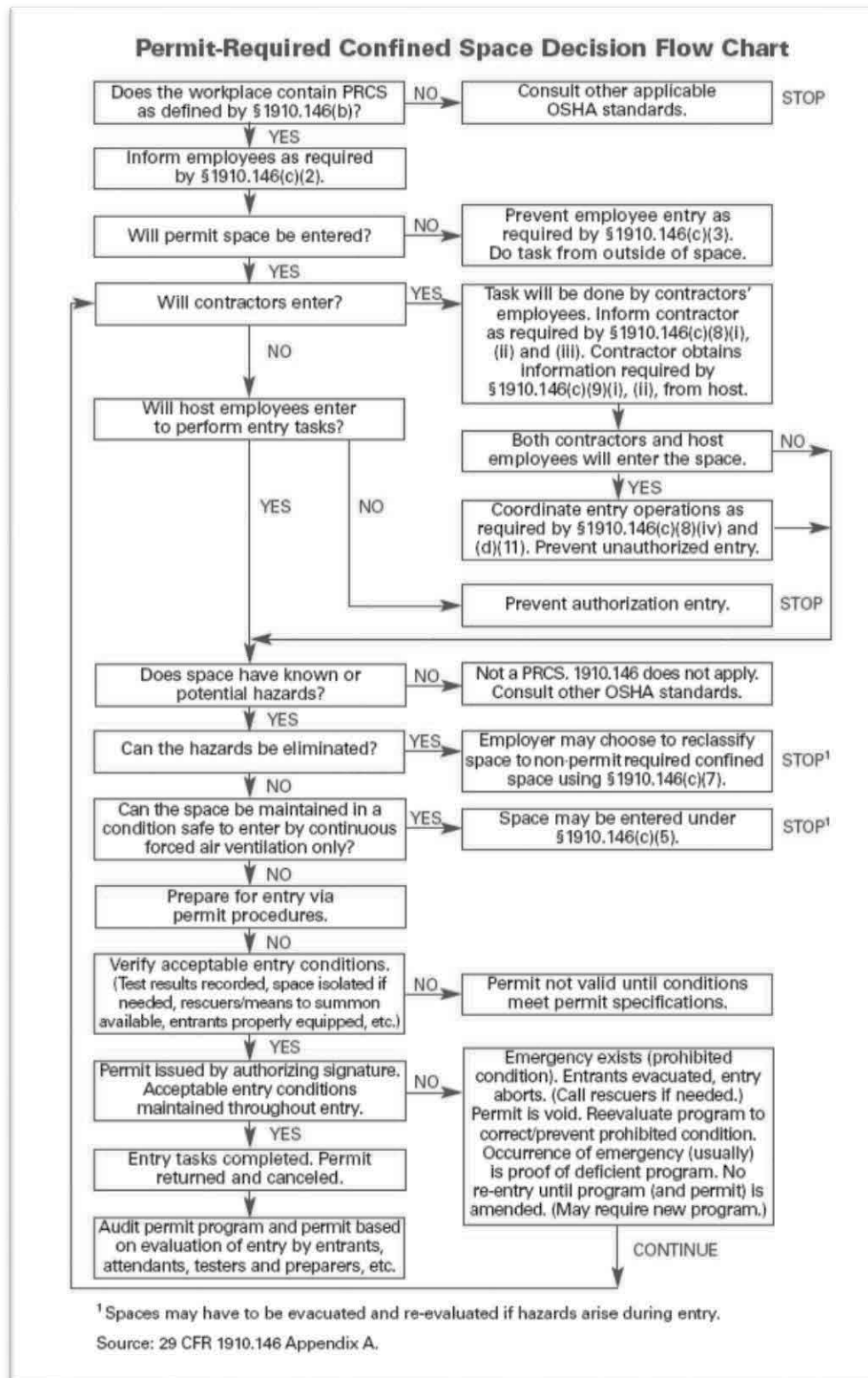
1. Is confined space entry always necessary for this task?
2. Is it possible to complete the task from the outside?

If possible, avoid entering a confined space. Every consideration should be given to completing the task from the outside.

Using alternative entry procedures

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

Flow Chart



Module 1 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. Which of the following is not one of the three OSHA-defined criteria of a confined space?**
 - a. large enough for a person to enter and work
 - b. has limited entry and exit
 - c. contains a ladder and hatch for entry
 - d. is not designed for continuous occupancy

- 2. One of the most difficult confined space entries to control is that of _____ entry.**
 - a. unplanned
 - b. unauthorized
 - c. unknown
 - d. unpredictable

- 3. Which of the following is one of the four characteristics of a permit-required confined space?**
 - a. has the potential to engulf someone outside the space
 - b. does or may contain any level of noise
 - c. has outwardly converging walls
 - d. does or may contain a hazardous atmosphere

- 4. A confined space entry is considered to have occurred when any part of a person's body crosses the plane of an opening into the space.**
 - a. true
 - b. false

5. When using alternative confined space entry procedures, you must test the _____ of the space.

- a. configuration
- b. access/egress difficulty
- c. structural integrity
- d. internal atmosphere

Module 2: Confined Space Program Elements

Introduction

Now that we've covered some of the basic concepts we'll discuss the various components of a confined space entry program. If you allow employees entry into a permit space, you must develop and implement a written plan as part of your confined space entry program.

Elements of the confined space program

An effective confined space program will contain many important elements. Each of the elements should be describe in a written plan that includes a permit system. The items on the permit address the components of your written plan to ensure safety and health of all involved!

Workplace Evaluation Procedures- What is the written plan?

The written plan is an important element of the Confined Space Program because it helps to clarify what everyone is supposed to do and how to do it (a recurring theme). If everyone understands their duties and responsibilities, and is able to perform in a professional manner, the likelihood of serious accidents will decrease significantly. The written confined space safety plan should address the following:

- Identification of confined spaces
- Evaluation of permit spaces and hazards
- Development & implementation of safe entry operations
- Providing and maintaining all necessary equipment (PPE, monitors, etc.)
- Evaluating permit space conditions before & during entry operations
- Confined space entry team duties (authorized entrants, attendants, entry supervisors)
- Procedures for multiple spaces
- Confined space entry and rescue training
- Rescue & emergency procedures
- Entry permit procedures (issue, use, cancel)
- Measures implemented to prevent unauthorized entry

- Multi-employer entry procedures
- Procedures for concluding the entry (closing off the space)
- Review & evaluation of entry operations during the year (as needed)
- Annual permit space program review using the historic permits

Identify Confined Spaces

The first step in confined space program development is to identify confined spaces. Next, evaluate each confined space to determine if it is a permit space. Keep in mind, permit space has one or more of the characteristics listed below.

1. Contains - or could contain - an atmospheric hazard.
2. Contains material that could trap or bury an entrant.
3. Is shaped such that an entrant could become trapped or asphyxiated.
4. Contains any other safety or health hazard that could harm an entrant.

Take a look at the Confined Space Decision Tree to help determine if you have permit or non-permit confined spaces.

Warning signs

If a workplace contains permit spaces, the employer must inform exposed employees of their existence, location and the hazards they pose. When your employees will not enter confined spaces, you must place warning signs that prohibit entry and take other effective measures that prevent them from entering confined spaces. This can be done by posting danger signs such as "DANGER -- PERMIT-REQUIRED CONFINED SPACE -- AUTHORIZED ENTRANTS ONLY" or using an equally effective means.

Usually "effective measures" means making sure employees can't get into the confined space without unlocking or unbolting a hatch. It should not be easy to get in to a confined space. Hatches and covers must be relatively difficult to open.

Hazard identification procedures

Identify and evaluate permit space hazards before allowing employee entry. This should be done initially and prior to each entry if the space is designated a confined space. You must identify all existing or potential hazards in each permit space at your workplace. Those who

enter permit spaces face two kinds of hazards: atmospheric and non-atmospheric. Atmospheric hazards affect the air in the space and can be flammable, toxic, corrosive, or asphyxiating.

Test atmospheric conditions in the permit space before entry operations and monitor the space during entry. Always test the atmosphere as most confined space injuries and fatalities are caused by hazardous atmospheres. Be especially careful when evaluating a space that could contain an atmospheric hazard! The only way to identify an atmospheric hazard is to test for it from outside the space.

Perform appropriate testing for the following atmospheric hazards in this sequence: oxygen, combustible gases or vapors, and toxic gases or vapors. Remember "O-F-T" and you can't go wrong.

Always test for atmospheric hazards in the following order:

1. O - oxygen deficiency, enrichment or displacement
2. F - flammable or explosive atmospheres
3. T - toxic or corrosive atmospheres

Never assume a confined space is hazard-free. Non-atmospheric hazards include conditions such as:

- mechanized equipment
- loose materials
- excessive noise
- extreme temperatures
- low light
- difficult access
- psychological stress

Procedures and practices

Once you analyze and determine the hazards and nature of the external and internal environment, you must develop procedures and practices to make sure the work is safe. Establish and implement the means, procedures and practices to eliminate or control hazards necessary for safe permit space entry operations. Have ways to eliminate the hazards if they're detected. Identify employee job duties. Entry supervisors, attendants and authorized entrants must know their jobs. We'll cover all of these topics in future modules.

Review established entry operations annually and revise the permit space entry program as necessary. An annual review and refresher training is important. Practice rescue if you have a team at least annually.

Entry permit system

Establish, in writing, and implement a system for the preparation, issue, use and cancellation of entry permits. If it meets the requirements for a permit, you must complete the permit before entry. An entry permit must be developed and used for each entry into a permit-required confined space.

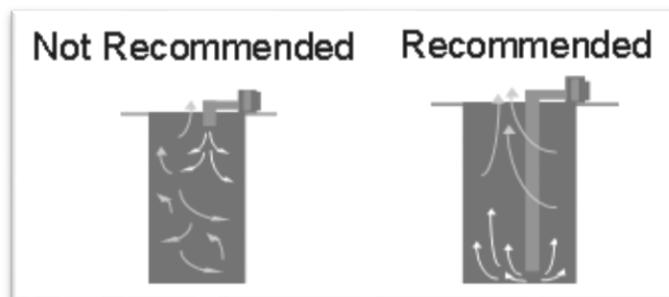
Employee training for authorized entrants, attendants, and entry supervisors

You must train entry procedures and practices for the specific space being entered. The training must specify confined space entry team (supervisor, attendant, and entrant) duties and responsibilities. Ensure that at least one attendant is stationed outside the permit space for the duration of entry operations. Coordinate entry operations when employees of more than one employer are working in the permit space. Typically the Entry Supervisor does this. You'll read more about confined space entry team duties and responsibilities in Module 7.

Controlling confined space hazards

Your written confined space plan should establish the means, procedures and practices to eliminate or control hazards necessary for safe permit space entry operations. These may include:

- Specifying acceptable entry conditions;
- Isolating the permit space;
- Providing barriers;
- Verifying acceptable entry conditions; and
- Purging, making inert, flushing or ventilating the permit space.



Equipment and Resources for safe entry

The employer must provide and maintain, at no cost to the employee, confined space entry tools, equipment, materials and whatever it takes to make sure they are safe while working in a confined space. The employer must also insist that employees use the confined space entry

equipment they have been provided. Don't do confined space entry "on the cheap" as it could kill a worker. A quality personal protective equipment program will pay for itself in the long term.

Once again, providing work equipment and PPE at no cost to employees is an absolute must do. In addition to personal protective equipment, other equipment that employees may require for safe entry into a permit space includes:

- Testing, monitoring, ventilating, communications and lighting equipment;
- Barriers and shields;
- Ladders; and
- Retrieval devices.

A measurement system

You must develop and deploy a system to ensure that pre-entry testing is performed, pre-entry preparation is completed, and acceptable conditions are attained. Typically a periodic audit of the confined space entry plan, procedures, and observation of practices will help to continually improve the confined space program.

Confined Space Rescue Plan

Implement appropriate procedures for summoning rescue and emergency services, and preventing unauthorized personnel from attempting rescue. You're either going to have your own rescue team, or rely on a 911 emergency rescue service. If your company doesn't rely on emergency responders (911 system), you must develop and deploy your own rescue team. The rescue team must be trained, and practice drills should be conducted at least annually.

Implement the procedures that any attendant who is required to monitor multiple spaces will follow during an emergency in one or more of those spaces. The attendant must be able to perform "non-entry" rescue. The attendant is not supposed to enter the confined space to rescue a worker. Most confined space fatalities are rescuers!

Annual Program Evaluation

It's important to review and evaluate the components of the confined space entry program. Make sure you review established entry operations annually and revise the permit space entry program as necessary. Evaluate the written plan and the procedures to see how well they work. To do that, make sure you observe confined space entry procedures, interview confined space team members, and review permits and training records.

Module 2 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. A confined space written plan is important because it helps to _____.**
 - a. establish fault
 - b. complicate perceptions
 - c. clarify duties and responsibilities
 - d. simplify procedures and practices

- 2. According to the text, what is the first step in confined space program development?**
 - a. contact OSHA
 - b. identify confined spaces
 - c. evaluate permit space hazards
 - d. train rescuers

- 3. Which of the following are considered effective measures to prevent unauthorized entry into a confined space?**
 - a. tagging or posting signs on hatches
 - b. tagging or latching hatches
 - c. tagging or locking hatches
 - d. locking or bolting hatches

- 4. Which of the following is the correct order for testing atmospheric hazards prior to entry into a confined space?**
 - a. O-F-T
 - b. F-O-T
 - c. T-F-O
 - d. O-T-F

5. Evaluating the confined space program may be conducted by _____.

- a. observing procedures
- b. reviewing permits
- c. interviews
- d. all of the above

Module 3: The Confined Space Entry Permit

Purpose of Confined Space Entry Permit

An entry permit is a document prepared by the employer or employer representative. It is designed to be used as a checklist to document the completion of all steps necessary to prepare for safe entry and work in a confined space.

The entry supervisor must sign the entry permit to:

1. ensure that acceptable conditions have been attained in the permit space and
2. authorize entry.

Further, you must post the permit near the confined space entry for entrants to verify that pre-entry procedures have been completed.

Sections of the entry permit

The entry permit must include:

- The location of the permit space to be entered. The specific location with the facility or site should be noted.
- The purpose of the entry. The permit must state the specific purpose of the work being performed.
- The date and the authorized duration of the entry permit. The permit must indicate when and how long the work is going to occur.
- The names of authorized entrants, attendants, and entry supervisors. The permit must list all workers who will be working within the space, attending to the workers, and the person supervising the entry.
- The hazards of the permit space. All hazards (electrical, mechanical, environmental, etc.) must be listed.
- The measures used to eliminate, isolate, or control permit space hazards before entry. The permit must list the procedures used to totally eliminate a hazard, isolate the space from hazards, or control the hazards. Lockout, block out, and ventilation are common measures.
- The acceptable entry conditions. The permit must list acceptable LELs, PELs, etc.

- The results of initial and periodic tests performed, along with the names of the testers and when these tests were performed.
- The verified rescue and emergency services to be summoned. Enter the on-site or off-site rescue services.
- The communication system. List the type of equipment that will be used to make sure direct communication is available.
- The equipment to be used during entry. Tools, equipment, personal protective equipment, electrical protective equipment, fall protection, etc., must be listed.
- Any additional information necessary to ensure employee safety.
- Any additional permits issued to authorize special work in the space. For example, a Hot Work Permit may be required.

Permit validity

The entry permit is valid once it has been signed by the entry supervisor. An entry permit is valid for more than one shift if it contains adequate information and the following criteria is met:

- Names of all involved employees (entry team plus next shift).
- Clearly delineated transfer of responsibilities from one shift to another.
- Acceptable entry conditions are maintained.
- Entry operations remain consistent with terms of the entry permit.

Cancelling entry permits

The entry supervisor must cancel entry permits when an assignment is completed or when new conditions exist. New conditions must be noted on the canceled permit and used in revising the permit space program. The OSHA confined space standard requires that the employer keep all canceled entry permits for at least one year.

Entry permit maintenance

The entry permit should be kept on file for one year. The annual review of canceled permits allows employers to assess and revise, if needed, their permit space program to ensure that confined space workers are protected from space hazards. See below for a sample permit:

Sample Permit

A Sample Permit

XYZ Inc., Confined Space Entry Permit (Example)

Date & Time Issued _____ Date & Time Expires _____
 Job site/space I.D. _____ Job Supervisor _____
 Equipment to be worked on _____ Work to be performed _____
 Entrants _____
 Stand-by personnel _____

1. Atmospheric checks Time _____
 Oxygen _____%
 Explosive _____% LFL
 Toxic _____PPM

2. Tester's signature _____

3. Source isolation (No Entry) NA Yes No
 Pumps or lines blinded,
 disconnected or blocked _____

4. Ventilation Modification
 Mechanical _____
 Natural Ventilation only _____

5. Atmospheric check after
 isolation and ventilation
 Time _____
 Oxygen _____% > 19.5%
 Explosive _____%LFL < 10%
 Toxic _____PPM < 10 PPM H₂S
 Tester's signature _____

6. Communication procedures _____

7. Rescue procedures: _____

8. Entry, standby, backup persons
 Training completed? Yes _____ No _____
 Training current? Yes _____ No _____

9. Equipment	NA	Yes	No
Direct reading gas monitor tested?	_____	_____	_____
Safety harnesses/lifelines for entrants/standby crew?	_____	_____	_____
Hoists	_____	_____	_____
Powered communications?	_____	_____	_____
SCBA's for entrants and standby crew?	_____	_____	_____
Protective clothing?	_____	_____	_____
All electric equipment listed Class I, Div I, Group D and non-spark producing?	_____	_____	_____

10. Periodic atmospheric tests

Time _____	O ₂ _____%	Explosive _____%	Toxic _____%
Time _____	O ₂ _____%	Explosive _____%	Toxic _____%
Time _____	O ₂ _____%	Explosive _____%	Toxic _____%
Time _____	O ₂ _____%	Explosive _____%	Toxic _____%
Time _____	O ₂ _____%	Explosive _____%	Toxic _____%
Time _____	O ₂ _____%	Explosive _____%	Toxic _____%
Time _____	O ₂ _____%	Explosive _____%	Toxic _____%

We have reviewed the work authorized by this permit and the information contained herein. Written instructions and safety procedures have been received and are understood. Entry cannot be approved if any column is marked "no". This permit is not valid unless all appropriate items are completed.

Permit prepared by: (Supervisor) _____

Approved by: (Unit Supervisor) _____

Reviewed by: (CS Ops Personnel) _____
 (Printed Name) (Signature)

Module 3 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. Which of the following is a purpose for the confined space entry permit?**
 - a. used as a checklist
 - b. documents entry preparation steps
 - c. helps prepare team for safe entry
 - d. all of the above

- 2. Which of the following is not a required section on the confined space entry permit?**
 - a. hazards of the confined space
 - b. name of the company safety manager
 - c. equipment to be used during entry
 - d. verified rescue and emergency services

- 3. Who must sign the entry permit before it is considered valid?**
 - a. department supervisor
 - b. safety officer
 - c. attendant
 - d. entry supervisor

- 4. The entry supervisor must cancel entry permits when an assignment is completed or when new conditions exist.**
 - a. true
 - b. false

- 5. The OSHA confined space standard requires that the employer keep all canceled entry permits for at least _____.**
- a. one year
 - b. two years
 - c. three years
 - d. five years

Module 4: Confined Space Atmospheric Hazards

Introduction

Many confined space accidents occur because the workers did not realize the dangers or potential dangers within or nearby the space. Workers may not take into account the new hazards and other conditions created during work in confined spaces. Thus, it is crucial to carefully identify all confined space hazards before entering a space.

Confined space hazard categories

Usually, confined space incidents are caused by multiple factors. There are two primary categories of hazards:

1. Atmospheric, or those that involve problems with the air in the space (lack of oxygen, the presence of other gases in the space, etc.) and
2. Non-atmospheric, physical, or those hazards that are caused either by equipment (rotors, sparks, etc.) or by other dangerous conditions (slippery surfaces, heat, etc.).

It is critical that you identify all the hazards in a space and determine how they can impact the health and safety of workers who enter this space.

Hazardous atmospheres

A hazardous atmosphere is any atmosphere that may incapacitate, injure, or impair an employee's self-rescue or lead to acute illness or death to workers and rescuers who enter confined spaces.

The following are examples of hazardous atmospheres within a confined space:

- Flammable or explosive gas, vapor, or mist in a concentration greater than 10 percent of its lower flammable limit (LFL) or lower explosive limit (LEL).
- Combustible dust suspended in air, which obscures vision at a distance of five feet or less.
- Atmospheric oxygen concentration levels below 19.5 percent or above 23.5 percent at sea level.
- Atmospheric concentration of any substance with an acutely toxic effect above its PEL, and any other atmospheric condition that is IDLH.

This does not include atmospheric concentrations of substances that are not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness.

Acceptable atmospheric conditions

For guidance, refer to sources of information such as a Material Safety Data Sheet (MSDS) that comply with published scientific and industry information, and National Consensus Standards from organizations such as the American Conference of Governmental Industrial Hygienists (ACGIH) and the National Institute for Occupational Safety and Health (NIOSH).

Oxygen deficiency

The normal atmosphere is composed approximately of 20.9% oxygen and 78.1% nitrogen, and 1% argon with small amounts of various other gases.

- Oxygen deprivation is one form of asphyxiation. While it is desirable to maintain the atmospheric oxygen level at 21% by volume, the body can tolerate deviation from this ideal.
- When the oxygen level falls to 17%, the first sign of hypoxia is a deterioration of night vision which is not noticeable until a normal oxygen concentration is restored. Physiologic effects are increased breathing volume and accelerated heartbeat.
- Between 14-16% physiologic effects are increased breathing volume, accelerated heartbeat, very poor muscular coordination, rapid fatigue, and intermittent respiration.
- Between 6-10% the effects are nausea, vomiting, inability to perform, and unconsciousness.
- Less than 6%, spasmodic breathing, convulsive movements, and death in minutes. Reduction of oxygen in a confined space may be the result of either consumption or displacement.
- The consumption of oxygen takes place during combustion of flammable substances, as in welding, heating, cutting, and brazing. A more subtle consumption of oxygen occurs during bacterial action, as in the fermentation process. Oxygen may also be consumed during chemical reactions as in the formation of rust on the exposed surface of the confined space (iron oxide). The number of people working in a confined space and the amount of their physical activity will also influence the oxygen consumption rate.

- A second factor in oxygen deficiency is displacement by another gas. Examples of gases that are used to displace air, and therefore reduce the oxygen level are helium, argon, and nitrogen. Carbon dioxide may also be used to displace air and can occur naturally in sewers, storage bins, wells, tunnels, wine vats, and grain elevators.

Aside from the natural development of these gases, or their use in the chemical process, certain gases are also used as inerting agents to displace flammable substances and retard pyrophoric reactions. Gases such as nitrogen, argon, helium, and carbon dioxide, are frequently referred to as non-toxic inert gases but have claimed many lives.

The use of nitrogen to inert a confined space has claimed more lives than carbon dioxide. The total displacement of oxygen by nitrogen will cause immediate collapse and death. Carbon dioxide and argon, with specific gravities greater than air, may lie in a tank or manhole for hours or days after opening. Since these gases are colorless and odorless, they pose an immediate hazard to health unless appropriate oxygen measurements and ventilation are adequately carried out.

Oxygen enrichment

Oxygen enrichment refers to air containing more than 23.5 percent oxygen. This dangerous condition is an extreme fire hazard in which static electricity from materials such as hair or clothing can provide the ignition source needed to start a fire. This environment also allows any fire to burn more readily. Oxygen enrichment does not occur naturally and should be investigated.

Oxygen enrichment can be caused by leaking oxygen cylinders or hoses that have been brought into or near the space. Always ventilate confined spaces with normal, ambient air. Never use pure oxygen.

Combustible and flammable gases

Atmospheres containing combustible or flammable gases or vapors can be dangerous because of the threat of fire and explosion.

Three ingredients are necessary for an atmosphere to become flammable or explosive:

1. an ignition source (heat or flame),
2. fuel (combustible gas or vapor), and
3. oxygen.

However, the proportions of fuel and oxygen in a mixture must be within the flammable range for this mixture to be readily ignitable.

Lower Flammability Limits (LFL) and Lower Explosive Limits (LEL)

The lower explosive limit, or LEL, is the lowest atmospheric concentration of fuel in the fuel-air mixture at which a gas or vapor can explode. The lower flammable limit, or LFL, is the lowest concentration at which the gas or vapor will burn. Fuel concentrations below the LEL and LFL will not explode or burn because there is not enough fuel in the mixture and is considered too "lean".

For example, the lean flammability limit for Jet A (aviation kerosene) in air at sea level is a concentration (by volume or partial pressure) of about 0.7%. The rich flammability limit is about 4.8% by volume or partial pressure. Flammability limits are not absolute, but depend on the type and strength of the ignition source.

Upper Explosive Limit (UEL) and Upper Flammability Limit (UFL)

The highest atmospheric concentration of a gas or vapor in the fuel-air mixture that can explode is called the upper explosive limit, or UEL. The upper flammability limit, or UFL, is the maximum fuel concentration above which the mixture will not burn. Above this concentration, the mixture will not explode or burn because it has too much fuel and is considered too "rich".

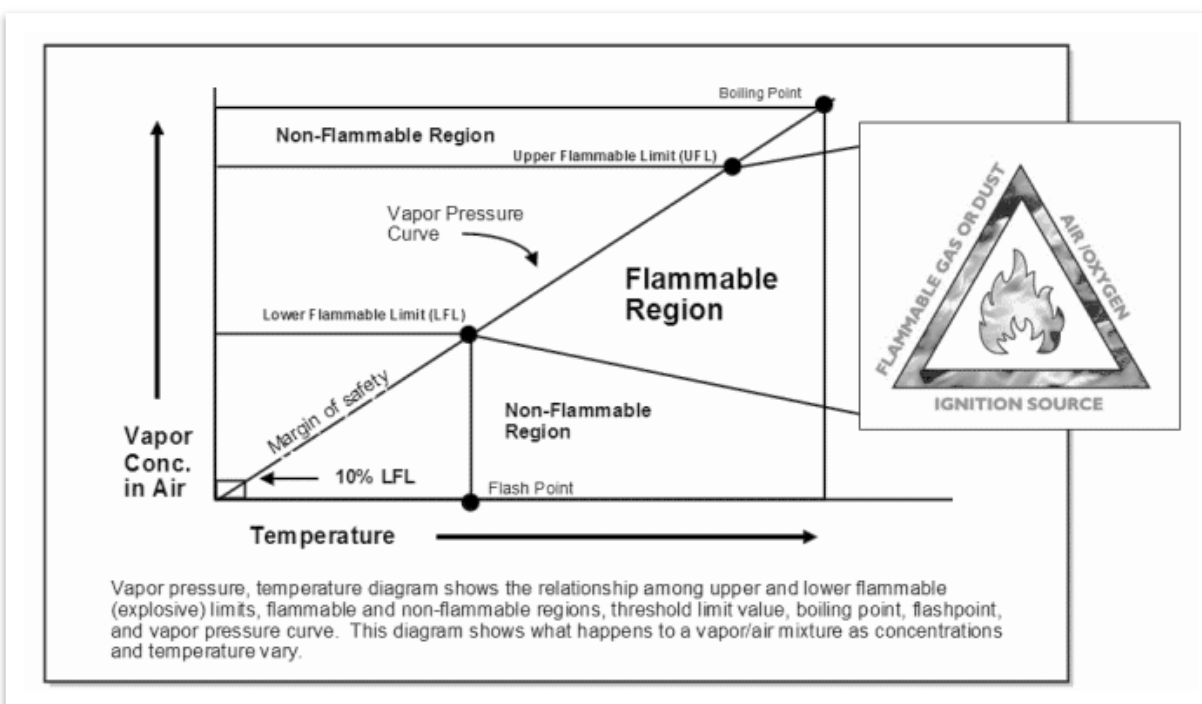
The composition of a fuel vapor and air mixture can change over time and may fluctuate within a confined space. Fluctuations occur because the fuel-air mixture moves around the space, particularly when people or other things create air currents that disturb the atmosphere. Consequently, the mixture is not uniformly distributed within the space.

Flammable Range

Gases or vapors can only be explosive or flammable between their LEL/LFL and UEL/UFL. This is called the explosive/flammable range. Substances with a wide explosive/flammable range are considered to be more hazardous since they are readily ignitable over a wider range. However, any concentration of combustible gas or vapor should be of serious concern in a confined space. Workers should be especially careful when ventilating a space containing a gas or vapor above its UEL/UFL. In order to reduce the concentration below the LEL, this procedure will first bring the gas or vapor within its explosive/flammable range. When it does, the possibility of an exposure or fire exists.

The diagram on the right shows the relationship among the lower and upper explosive/flammability limits, explosive/flammable and non-explosive/flammable regions, flash

points, and the vapor pressure curve. It also reveals what happens to a vapor/air mixture as concentrations and temperatures vary.



Combustible dust atmospheres

Finely powdered dust from combustible materials such as wood, metal, or grain can be fuel for powerful explosions. Dust clouds can develop as result of handling dusty materials or when solid materials are reduced to smaller particles from processes such as grinding, drilling, or crushing.

Airborne combustible dust at an explosive concentration would obscure vision at a distance of five feet (1.52 meters) or less. A direct reading instrument may be used to measure actual dust concentrations.

Toxic atmospheres

Substances regarded as toxic in a confined space can cover the entire spectrum of gases, vapors, and finely-divided airborne dust in industry. Toxic gases may be present in a confined space because:

- toxic substances are used as part of the production process, (for example, in producing polyvinyl chloride, hydrogen chloride is used as well as vinyl chloride monomer, which is carcinogenic).

- the biological and chemical "breakdown" of the product being stored in a tank, or
- maintenance activities (welding) being performed in the confined space.

Four common types of toxic gases encountered in confined spaces are:

1. Hydrogen Sulfide (H₂S) - "sewer gas" a colorless gas with the odor of rotten eggs. Excessive exposure has been linked to many confined space deaths. Hydrogen sulfide causes a loss of our sense of smell, causing people to mistakenly think that the gas has left the space. Hydrogen sulfide inhibits the exchange of oxygen on the cellular level and causes asphyxiation.
2. Carbon monoxide (CO) - is an odorless, colorless gas that is formed by burning carbon based fuels (gas, wood). Carbon monoxide inhibits the body's ability to transport oxygen to all parts of the body.
3. Methane (CH₄) is a natural gas produced from the decay of organic matter. It is a flammable, explosive, colorless, and odorless gas. It can displace oxygen to the point of oxygen deficiency in a confined space, causing dizziness, unconsciousness, and asphyxiation.
4. Solvents - many solvents, such as kerosene, gasoline, paint strippers, degreasers, etc. are not only flammable, but if inhaled at high concentrations can cause central nervous system (CNS) effects. CNS effect can include dizziness, drowsiness, lack of concentration, confusion, headaches, coma and death.

(Source: University of South Carolina)

Remember, atmospheric changes may occur due to the work procedure, the product stored, or a nearby gas line leak. The atmosphere may be safe upon entry, but can change very quickly.

- The work performed within the confined space (such as welding, degreasing, painting, or sanding) may produce toxic atmospheres.
- Toxic gases and vapors from adjacent areas can migrate to and collect in the confined space.
- Vapors may be released from the sludges on the bottom or scales on walls of emptied confined spaces, such as storage tanks, that previously contained flammable or toxic chemicals. Vapor release may be accelerated by wall scraping and sludge removal from confined spaces.

Confined spaces prevent toxic substances from escaping, diluting, or readily dissipating. Instead, substances can become trapped and a buildup occurs, whereby the concentrations of toxic substances reach dangerous levels.

The atmosphere inside a confined space can change rapidly and unexpectedly. Also, any ignition source (such as sparks from grinding or welding equipment, static electricity, or unapproved electrical equipment that is not non-sparking or even smoking) can initiate an explosion.

Irritant/Corrosive Atmospheres

Irritant or corrosive atmospheres can be divided into primary and secondary groups.

1. The primary irritants exert no systemic toxic effects (effects on the entire body). Examples of primary irritants are chlorine, ozone, hydrochloric acid, hydrofluoric acid, sulfuric acid, nitrogen dioxide, ammonia, and sulfur dioxide.
2. A secondary irritant is one that may produce systemic toxic effects in addition to surface irritation. Examples of secondary irritants include benzene, carbon tetrachloride, ethyl chloride, trichloroethane, trichloroethylene, and chloropropene.

Irritant gases vary widely among all areas of industrial activity. They can be found in plastics plants, chemical plants, the petroleum industry, tanneries, refrigeration industries, paint manufacturing, and mining operations.

Prolonged exposure at irritant or corrosive concentrations in a confined space may produce little or no evidence of irritation. This may result in a general weakening of the defense reflexes from changes in sensitivity. The danger in this situation is that the worker is usually not aware of any increase in his/her exposure to toxic substances.

Examples of Corrosives

- Bleach
- Ammonia
- Acids

The Material Safety Data Sheet (MSDS)

To find out information on the hazardous substances used in a confined space, read the product label and/or the MSDS. Labels provide general product information, and the MSDS gives useful information on proper use and handling, special precautions, and first aid

treatment. When a chemical product is purchased, the manufacturer or supplier of the product provides an MSDS. The MSDS must be readily available to any employee who wishes to learn about a product that he or she comes into contact with. If you have any questions, contact your safety Department, the manufacturer or supplier of the product, the [NIOSH Pocket Guide to Chemical Hazards](#), or a consultant. Here is a [sample MSDS](#)

Monitoring and testing for hazardous atmospheres

Atmospheric testing is required for two distinct purposes:

1. Evaluation of the hazards of the permit space, and
2. Verification that acceptable entry conditions for entry into that space exist

Continual monitoring in confined spaces is necessary because there are unseen and odorless contaminants (or oxygen-deficient atmospheres) that can kill or incapacitate workers.

Monitoring is the only way to detect whether a hazardous atmosphere has developed during entry. If this is the case, employees will be alerted to the change so they can leave the space immediately.

Of those contaminants that have odor, some can be detected by our senses only at low concentration. Hydrogen sulfide, for example, will deaden the sense of smell at high concentrations. Because of this, employees might assume that a confined space is safe when it is not. There is no substitute for testing the air in a confined space prior to entry. A worker can also be exposed to a contaminant through skin contact while working in a confined space.

Atmospheric monitoring is necessary whenever:

- A safe atmosphere cannot be ensured.
- An existing hazardous atmosphere cannot be removed.
- The confined space cannot be physically isolated from the penetration of hazardous materials.
- There is reason to suspect the development of a hazardous atmosphere during work activity.

The "OFT" order of testing in confined spaces

Always test for atmospheric hazards in the following order:

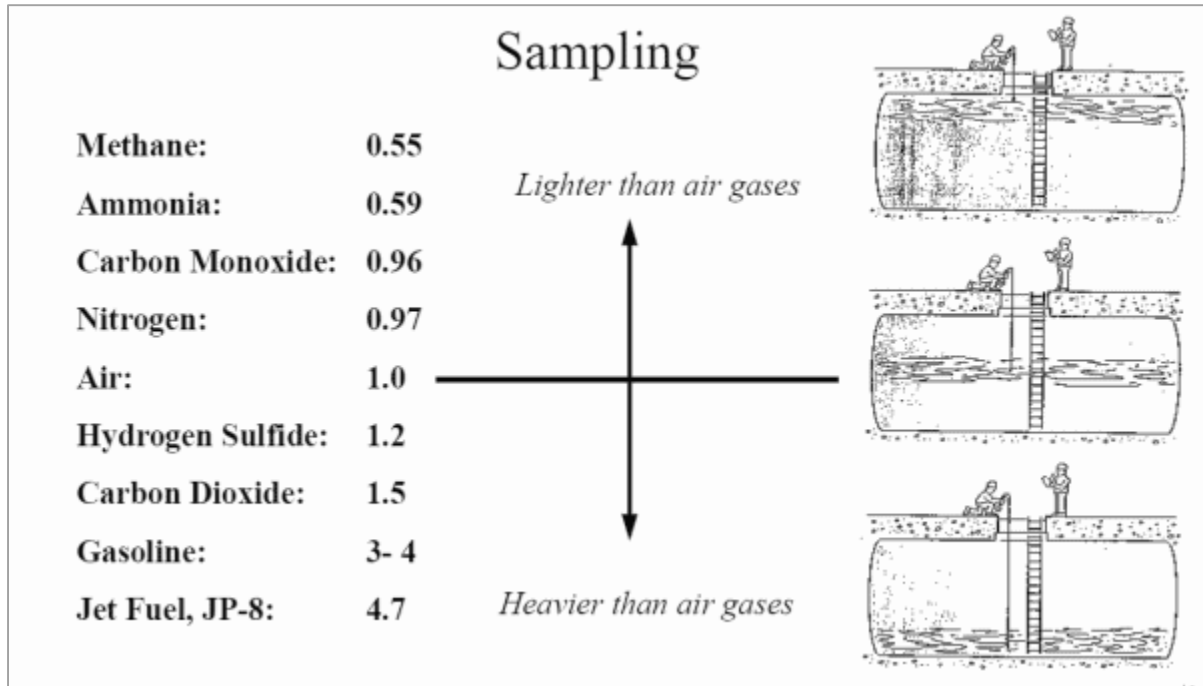
1. Oxygen is tested first because most combustible gas and toxic atmosphere meters are oxygen-dependent and will not provide reliable readings when used in oxygen-deficient atmospheres. In addition, both oxygen-deficient and oxygen-enriched atmospheres are extremely hazardous to workers' health and safety. Oxygen levels should be between 19.5% - 23.5%.
2. Flammable or explosive gases and vapors are tested next because the threat of fire and explosion is both more immediate and more life-threatening, in most cases, than exposure to toxic gases and vapors. Flammability limits should be less than 10% of the Lower Flammability Limit (LFL)
3. Toxic atmospheres are tested last. Many modern direct-reading instruments provide simultaneous readings of multiple gases. Readings should be less than recognized ACGIH exposure limits or other published exposure levels (e.g. OSHA PELs, NIOSH RELs).

Atmosphere Sampling Procedure

The atmosphere of a confined space should be analyzed using equipment of sufficient sensitivity and specificity to identify and evaluate any hazardous atmospheres that may exist or arise, so that appropriate permit entry procedures can be developed and acceptable entry conditions stipulated for that space.

Evaluation and interpretation of this data, and development of the entry procedure, should be done by, or reviewed by, a technically qualified professional (e.g., OSHA consultation service, or certified industrial hygienist, registered safety engineer, certified safety professional, certified marine chemist, etc.) based on evaluation of all serious hazards.

The atmosphere of a permit space should be tested for residues of all contaminants identified by evaluation testing to determine that residual concentrations at the time of testing and entry are within the range of acceptable entry conditions.



When monitoring for entries involving a descent into atmospheres that may be stratified, the atmospheric envelope should be tested a distance of approximately 4 feet (1.22 m) 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.

Results of testing (i.e., actual concentration, etc.) should be recorded on the permit in the space provided adjacent to the stipulated acceptable entry condition.

If entrants leave the confined space for any reason, they should once again test the atmosphere within confined spaces because it can change rapidly.

Test results that show the composition of an atmosphere to which employees are actually exposed (even if the employees are using respirators) must be available so that they can be reviewed by members of the entry team or representatives.

Direct-reading testing instruments

Electronic gas detectors and color-indicator gas detector tubes are the most common types of instruments used for determining oxygen content, lower explosive limit, and toxic atmospheres.

Purchasing monitoring equipment

The typical confined space gas monitors will offer up to four independent sensors for the detection of oxygen, combustible gas, carbon monoxide, and hydrogen sulfide. Before purchasing confined space testing equipment, it is important to evaluate the instrument:

- Accuracy.
- Environmental operating range:
 - Remote sampling capability.
 - Operating temperature.
 - Relative humidity.
- Intrinsic safety for explosive atmospheres.
- Specificity for contaminant of interest.
- Warm-up time.
- Response time.
- Ruggedness.
- Ease of use and maintenance.
- Vendor support.
- Sensor and battery life.
- Data-logging capabilities.

What does "immediately dangerous to life or health" (IDLH) mean?

This term refers to any condition in a permit space that would:

1. Cause irreversible adverse health effects; or
2. Interfere with self-rescue; or
3. Cause immediate or delayed threat to life or health.

Permissible Exposure Limits (PELs)

Permissible exposure limits, or PELs, are occupational exposure standards that refer to the maximum concentration of airborne chemicals to which nearly all healthy persons can be exposed day after day without adverse health effects. Workers' exposure to concentration of materials in excess of the PEL can result in detrimental health effects, including illness and/or death.

Module 4 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. Which of the following are the two primary categories of confined space hazards?**
 - a. psychological and physical
 - b. falls and tripping
 - c. electrical and hydraulic
 - d. atmospheric and non-atmospheric

- 2. Which of the following is an example of a hazardous atmosphere in a confined space?**
 - a. temperature at 4 °C
 - b. combustible dust
 - c. oxygen level at 21% O²
 - d. concentration of toxic gas below its PEL

- 3. Which of the following can cause oxygen deficiency in a confined space?**
 - a. a dead rodent
 - b. formation of rust
 - c. welding
 - d. all of the above

- 4. According to the text, what are the three ingredients necessary for an atmosphere to become flammable or explosive?**
 - a. ignition source, fuel, oxygen
 - b. ignition source, heat, air
 - c. fuel, heat, oxygen
 - d. oxygen, ignition source, proper sequence

5. Which of the following is not one of the four common types of toxic gases encountered in confined spaces?

- a. Hydrogen Sulfide (H^2S)
- b. Chlorine (CL)
- c. Methane (CH^4)
- d. Carbon monoxide (CO)

Module 5: Non-Atmospheric Hazards

Types of physical hazards encountered in confined spaces

Hazardous atmospheres are not the only hazards within confined spaces. As we'll see there are many actual and potential non-atmospheric hazards within confined spaces and we need to be aware of them to make sure they are eliminated.

Mechanical Hazards

If activation of electrical or mechanical equipment would cause injury, each piece of equipment should be manually isolated to prevent inadvertent activation before workers enter or while they work in a confined space.

The interplay of hazards associated with a confined space, such as the potential of flammable vapors or gases being present, and the build-up of static charge due to mechanical cleaning, such as abrasive blasting, all influence the precautions which must be taken.

- To prevent vapor leaks, flashbacks, and other hazards, workers should completely isolate the space.
- To completely isolate a confined space, the closing of valves is not sufficient.
- All pipes must be physically disconnected or isolation blanks bolted in place.
- The pipes blanked or disconnected should be inspected and tested for leakage to check the effectiveness of the procedure.
- Other areas of concern are steam valves, pressure lines, and chemical transfer pipes.

A less apparent hazard is the space referred to as a void, such as double walled vessels, which must be given special consideration in blanking off and inerting. Other special precautions must be taken in cases where flammable liquids or vapors may re-contaminate the confined space.

Skin Contact Hazards

Toxic solvents, chemical removers, and flammable and combustible liquids can harm employees eyes and skin. Workers should understand the hazards associated with the materials used and contained in the space. This includes training in accordance with the Hazard Communication Standard. Hazards may include:

- Organ damage by absorption through the skin or eye.

- Eye or skin irritation.
- Defatting of skin.

Requirements and Example Solutions:

- Use appropriate personal protective equipment (PPE).
- Clean up spills or other releases of flammable, combustible, toxic, corrosive and irritant materials as work progresses.
- Ensure that washing facilities are available.

Limited Access Hazards

When working in confined or enclosed spaces, egress may be blocked by:

- Improperly located equipment.
- Temporary ventilation ducts and hoses running through the entrance.
- "Interference" such as piping, ventilation ducts, and electrical wiring.

Requirements and Example Solutions:

- When employees work in confined or enclosed spaces with limited access, the access must not be blocked or impeded by ventilation ducts, hoses, or other equipment.
- More than one means of access must be provided where practical.
- Additional openings should be considered for ducts, hoses, and other equipment.

Slip and Trip Hazards

Workers can be exposed to slippery working surfaces and tripping hazards. This places workers at risk of:

- Slipping off oily and greasy ladders.
- Slipping and falling on oily surfaces.
- Tripping over equipment, hoses, and structures.

Requirements and Example Solutions:

- All spills should be cleaned up immediately.
- Visual inspection should be conducted.
- Adequate illumination should be provided.
- Housekeeping should be maintained.

Fall Hazards

Fall hazards are a leading cause of workplace fatalities. Employees are often required to work in dangerous environments that may include fall hazards. Accidents involving elevation equipment such as ladders, scaffolds, and aerial lifts are often serious, even fatal. Here are just a few scenarios where falls could occur:

- Deck Openings and Edges
- Falls from roof edges
- Falls from floor openings
- Falls into open holes
- Falls from ladders
- Falls from scaffolds

Personal Fall Protection System

If fall hazards are identified through a hazard assessment, employees must be protected from falls by the use of personal fall protection equipment including body harnesses and lifelines. Guardrails may be used to protect workers along floor openings or edges, in lieu of personal fall protection.

Work Environment Temperature Related Hazards

A thermal hazard is a dangerous condition caused by excessive heat or cold or a hot surface. Employees engaged in continuous heavy work while wearing PPE (e.g., body suit and respirator) in warm surroundings are particularly susceptible to thermal hazards. Heat stress may lead to heat exhaustion, heat cramps, heat stroke, loss of consciousness, or death. A confined space entry permit must address any hazards from heat or cold within confined spaces. A

combination of PPE use, heat-producing equipment, work activity, and environmental conditions can cause temperature-related illnesses.

Four factors influence the interchange of heat between people and their environment. They are:

1. air temperature,
2. air velocity,
3. moisture contained in the air, and
4. radiant heat.

Because of the nature and design of most confined spaces, moisture content and radiant heat are difficult to control. As the body temperature rises progressively, workers will continue to function until the body temperature reaches approximately 102°F. When this body temperature is exceeded, the workers are less efficient, and are prone to heat exhaustion, heat cramps, or heat stroke. In a cold environment, certain physiologic mechanisms come into play, which tend to limit heat loss and increase heat production. The most severe strain in cold conditions is chilling of the extremities so that activity is restricted. Special precautions must be taken in cold environments to prevent frostbite, trench foot, and general hypothermia.

Heat-related illnesses include:

- Heat Stress
- Heat Stroke
- Heat Cramps
- Dehydration

Cold-related illnesses include:

- Hypothermia
- Frost Bite

The following precautions for heat-related illnesses are recommended:

- Plenty of fluids
- Frequent breaks

- Ice vest
- Shaded or cooled break areas
- Ventilation
- Awareness training

The following precautions for cold-related illnesses are recommended:

- Appropriate insulated PPE
- Warming areas for breaks
- Awareness training

Communication Problems

Communication between the worker inside and the standby person outside is of utmost importance. If the worker should suddenly feel distressed and not be able to summon help, an injury could become a fatality. Frequently, the body positions that are assumed in a confined space make it difficult for the standby person to detect an unconscious worker. When visual monitoring of the worker is not possible because of the design of the confined space or location of the entry hatch, a voice or alarm-activated explosion proof type of communication system will be necessary.

Excessive Noise Hazards

Noise problems are usually intensified in confined spaces because the interior tends to cause sound to reverberate and thus expose the worker to higher sound levels than those found in an open environment. This intensified noise increases the risk of hearing damage to workers which could result in temporary or permanent loss of hearing. Noise in a confined space which may not be intense enough to cause hearing damage may still disrupt verbal communication with the emergency standby person on the exterior of the confined space. If the workers inside are not able to hear commands or danger signals due to excessive noise, the probability of severe accidents can increase.

If noise levels are high, a hearing conservation program may need to be implemented. Use of tools and equipment may produce high noise levels, which could lead to permanent hearing loss, and often necessitates a hearing conservation program. Some examples of excessively loud operations include:

- Use of high-pressure water and steam guns

- Abrasive Blasting
- Needle Gunning
- Scaling
- Grinding

Requirements and Example Solutions:

- Hearing protection
- Hearing conservation program

High-Pressure Hazards

The use of high-pressure equipment may expose operators and bystanders to the following hazards:

- Contact with high-pressure steam, water, grit, or air streams from cleaning equipment.
- Contact with uncontrolled high-pressure hoses.

Injuries associated with these hazards include:

- Loss of body parts (for example, fingers, or hands)
- Lacerations
- Burns
- Loss of sight

Requirements and Example Solutions:

- Use appropriate PPE.
- Control access to the area.
- Inspect hoses and connections prior to use.
- Use pressure equipment according to the manufacturer's recommendations.
- Warning: Do not use oxygen for cleaning (blow-off), operation of air tools, or ventilation

Electrical Hazards

Potential Hazards:

All workers who work with electrical equipment in wet or damp locations have an increased risk of getting shocked or electrocuted due to:

- Faulty electrical connection in power tools.
- Open lighting parts.
- Broken insulation on power cables and cords.

Requirements and Example Solutions:

- Portable electrical tools must be grounded or double insulated.
- Temporary lighting must be grounded.
- All electrical tools or equipment should undergo a visual inspection prior to use.
- All portable electric hand tools and temporary lighting systems should utilize Ground Fault Circuit Interrupters (GFCI).
- Electrical tools and equipment should correspond with the requirements of the job.
- Electrical equipment and tools should be used with proper circuit protection for the voltage and amperage used.
- Only qualified electricians should attempt to repair electrical tools and equipment.

A Ground Assurance Program should be in place for all electrical tools and equipment used including:

- Records of tools inspected and repaired.
- Records of electrical boxes inspected and repaired.
- Records of electrical extension cords inspected and repaired.
- Recall of records of the above.
- The requirements of the Ground Assurance Program should be performed on a regular basis.

Vibration

Whole body vibration may affect multiple body parts and organs depending upon the vibration characteristics. Segmental vibration, unlike whole body vibration, appears to be more localized in creating injury to the fingers and hands of workers using tools, such as pneumatic hammers, rotary grinders or other hand tools which cause vibration.

Impact Hazards

Workers may be exposed to impact hazards from:

- Sparks
- Metal particles
- Grinding debris
- Paint debris

Injuries may include:

- Particles becoming imbedded in the skin
- Eye damage
- Skin burns
- Skin trauma

Requirements and Example Solutions:

- Use PPE properly.
- Use powered equipment such as portable grinders with guards and according to the manufacturer's recommendations.

Moving equipment or parts and energized or pressurized systems can be dangerous. Examples include shafts, couplings, gears, belts, conveyors, mixers, rotors, and compressing devices.

Entrapment hazards

Entrapment hazards in confined spaces include inwardly converging walls or floors that slope downward and taper to a smaller cross-section (such as air plenums).

Engulfment

Engulfment refers to the surrounding or burial of the worker in a liquid or loose, finely divided solid material, such as sand or grain. Such materials can suffocate a worker. Examples include:

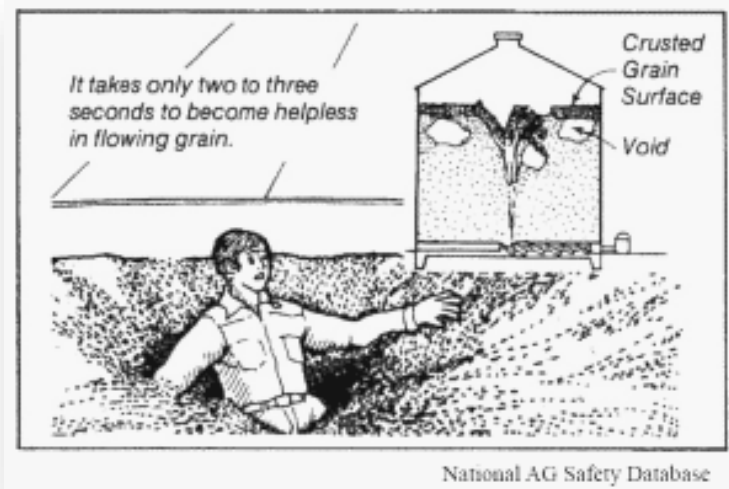
- Accidental dumping of a product on a worker.
- A worker walking on unstable material such as settled grain. Such materials could conceal a void underneath that gives way under the weight of the worker, resulting in engulfment.

General/Physical

Some physical hazards cannot be eliminated because of the nature of the confined space or the work to be performed. These hazards include such items as scaffolding, surface residues, and structural hazards. The use of scaffolding in confined spaces has contributed to many accidents caused by workers or materials falling, improper use of guard rails, and lack of maintenance to insure worker safety. The choice of material used for scaffolding depends upon the type of work to be performed, the calculated weight to be supported, the surface on which the scaffolding is placed, and the substance previously stored in the confined space.

Surface residues in confined spaces can increase the already hazardous conditions of electrical shock, reaction of incompatible materials, liberation of toxic substances, and bodily injury due to slips and falls. Without protective clothing, additional hazards to health may arise due to surface residues.

Structural hazards within a confined space such as baffles in horizontal tanks, trays in vertical towers, bends in tunnels, overhead structural members, or scaffolding installed for maintenance constitute physical hazards, which are exacerbated by the physical surroundings.



In dealing with structural hazards, workers must review and enforce safety precautions to assure safety.

Rescue procedures may require withdrawal of an injured or unconscious person. Careful planning must be given to the relationship between the internal structure, the exit opening, and the worker. If the worker is above the opening, the system must include a rescue arrangement operated from outside the confined space, if possible, by which the employee can be lowered and removed without injury.

Module 5 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. Fall hazards are a leading cause of confined space fatalities.**
 - a. true
 - b. false

- 2. What should be done if activation of electrical or mechanical equipment could cause injury while working in a confined space?**
 - a. stay clear of the equipment
 - b. isolate each piece of equipment
 - c. post warning signs
 - d. do not permit entry

- 3. To prevent slips and trips in a confined space, all of the following should occur, EXCEPT?**
 - a. maintain good housekeeping
 - b. visually inspect the space
 - c. ensure adequate illumination
 - d. clean up spills after work is finished

- 4. Heat stress may lead to which of the following?**
 - a. heat exhaustion
 - b. heat cramps
 - c. heat stroke
 - d. any of the above

5. _____ in confined spaces can increase the already hazardous conditions of electrical shock.
- a. roots invading the space
 - b. surface residues
 - c. residual static currents
 - d. too many entrants

Module 6: Controlling Confined Space Hazards

Introduction

Once hazards are identified, it is critical to institute appropriate control measures to eliminate or, if not possible, reduce and control confined space hazards. This module discusses the "Hierarchy of Controls" strategies to control confined space hazards. The moment of entry is critical in confined or enclosed space operations. Injuries from fires, explosions, falls, and unsafe atmospheres may be avoided with careful preparation and adequate testing. Remember, acceptable entry conditions must be attained before entry and those safe conditions must be maintained throughout the duration of an entry. This module also explains some of the procedures and precautions that should be in place to safeguard entrants while they are working in the confined space.

Hazard Elimination and Substitution

Elimination

The highest priority in controlling hazards in confined spaces should be given to the attempt to totally eliminate the hazard so that entry will be completely safe. That's not possible in many situations, but the attempt should still be considered. For instance, if there is a hazardous atmosphere in the confined space, forced-air ventilation of the space might be the answer to completely eliminate the hazard.

Substitution

If elimination is not possible, it may be acceptable to replace toxic substances with less toxic or non-toxic substances so that hazardous atmospheres are not created. One primary control measure effective in preventing toxic hazardous atmospheres from developing in the first place is the use of less toxic products that vaporize less readily. Keep less of the product at the site and keep containers closed inside the confined space at all times.

Confined space engineering controls

Engineering controls may be employed to design or redesign a confined space so that it hazardous atmospheres and substances do not develop in the workspace. Examples of engineering controls include: installing automatic ventilation systems, redesigning the entrance so that unlimited access is possible, and redesigning an old confined space with a safer confined space configuration.

Confined space administrative controls

Administrative controls are those controls which eliminate or reduce the hazard through changes in the work practice (e.g., rotating workers, reducing the amount of worker exposure, housekeeping). Confined spaces should be cleaned/decontaminated of hazardous materials to the extent feasible before entry. Cleaning/decontamination should be the preferred method of reducing exposure to hazardous materials. Where this is not practicable, PPE should be worn by the entry personnel to provide appropriate protection against the hazards which may be present.

Personal protective equipment (PPE)

If the hazard cannot be eliminated or reduced to a safe level through engineering and/or work practice controls, PPE should be used. A qualified person should determine PPE needed by all personnel entering the confined space, including rescue teams. PPE which meet the specifications of applicable standards should be selected in accordance with the requirements of the job to be performed.

Primary control-Toxic Atmospheres

One primary control measure effective in preventing toxic hazardous atmospheres from developing in the first place is the use of less toxic products that vaporize less readily. Keep less of the product at the site and keep containers closed inside the confined space at all times.

Ventilating confined spaces

Ventilation is one of the most common control methods used in confined spaces to eliminate hazardous atmospheres.

Ventilation helps to:

- Provide adequate oxygen to the air in the space.
- Control atmospheric contaminants.
- Prevent fire and explosion hazards.
- Control heat and humidity.

When ventilation is used to remove atmospheric contaminants from the confined space, the space should be ventilated until the atmosphere is within the acceptable ranges. Ventilation should be maintained during the occupancy if there is a potential for the atmospheric conditions to move out of the acceptable range.

Once it has been determined that the confined space contains a harmful atmosphere, the next step is to clear it. Ventilation blows out oxygen-deficient or contaminated atmospheres and replaces harmful vapors with clean, fresh air. Make sure to ventilate the space thoroughly so that there are no contaminated pockets left, and then test the atmosphere again.

For permit spaces that are deep or have areas leading away from the entry point, the atmosphere may be layered or may be different in remote areas. For these spaces, testing must be done in the area surrounding the worker, which is considered four (4) feet in the direction of travel and to each side. If a sample probe is used to do the testing, then the worker must move slowly enough so that testing is completed, keeping the equipment "response time" in mind, before he/she moves into the new area.

Welding, cutting, burning, and continuous brazing generate hazardous fumes and dusts that can be more effectively removed by local exhaust ventilation systems at or near the point of generation.

When ventilation is not possible or feasible, alternate protective measures or methods to remove air contaminants and protect occupants should be determined by the qualified person prior to authorizing entry.

Conditions regarding continuous forced air ventilation should be used as follows:

- Employees should not enter the space until the forced air ventilation has eliminated any hazardous atmosphere,
- Forced air ventilation should be so directed as to ventilate the immediate areas where an employee is or will be present within the space,
- Continuous ventilation is maintained until all employees have left the space, and
- Air supply for forced air ventilation should be from a clean source.

Considerations to ensure proper ventilation

Initially determine:

- Number and size of openings.
- Volume and configuration of the space to be entered.
- Capacity and positioning of the ventilation equipment to be used.
- Existing and potential atmospheric hazards.

After beginning ventilation:

- Routinely test the confined space until levels stabilize at acceptable entry conditions.

Once entry and work start:

- Continue ventilation and frequent atmospheric testing for the entire duration of entry.
- Consider atmospheric hazards created by work in the space.

Respiratory protection

Respiratory protection is needed whenever:

- An emergency exists and entry cannot be delayed. Assume that an IDLH atmosphere exists.
- There is an inert atmosphere or testing shows that an IDLH exists and additional ventilation cannot reduce concentrations to safe levels.
- Current testing indicates atmosphere to be safe, but unsafe conditions could reasonably be expected to develop at any time.

Confined Space Inspections

Inspecting your confined space entry program, procedures, and practices is an important part of the safety management system evaluation. Use a checklist like this to help identify strengths and weaknesses in the program.

1. _____ Are confined spaces thoroughly emptied of any corrosive or hazardous substances, such as acids or caustics, before entry?
2. _____ Are all lines to a confined space, containing inert, toxic, flammable, or corrosive materials valved off and blanked or disconnected and separated before entry?
3. _____ Are all impellers, agitators, or other moving parts and equipment inside confined spaces locked-out if they present a hazard?
4. _____ Is either natural or mechanical ventilation provided prior to confined space entry?
5. _____ Are appropriate atmospheric tests performed to check for oxygen deficiency, toxic substances and explosive concentrations in the confined space before entry?
6. _____ Is adequate illumination provided for the work to be performed in the confined space?

7. ____ Is the atmosphere inside the confined space frequently tested or continuously monitored during conduct of work?
8. ____ Is there an assigned safety standby employee outside of the confined space when required, whose sole responsibility is to watch the work in progress, sound an alarm if necessary, and render assistance?
9. ____ Is the standby employee appropriately trained and equipped to handle an emergency?
10. ____ Is the standby employee or other employees prohibited from entering the confined space without lifelines and respiratory equipment if there is any question as to the cause of an emergency?
11. ____ Is approved respiratory equipment required if the atmosphere inside the confined space cannot be made acceptable?
12. ____ Is all portable electrical equipment used inside confined spaces either grounded and insulated, or equipped with ground fault protection?
13. ____ Before gas welding or burning is started in a confined space, are hoses checked for leaks?
14. ____ Are compressed gas bottles forbidden inside of the confined space?
15. ____ Is the confined area tested for a flammable/explosive atmosphere prior to using electrical equipment/lights within the confined space?
16. ____ If the confined space may contain a potentially flammable/explosive atmosphere, are only intrinsically safe equipment and lights used within the confined space?
17. ____ If employees will be using oxygen-consuming equipment-such as salamanders, torches, and furnaces, in a confined space, is sufficient air provided to assure combustion without reducing the oxygen concentration of the atmosphere below 19.5 percent by volume?
18. ____ Whenever combustion-type equipment is used in a confined space, are provisions made to ensure the exhaust gases are vented outside of the enclosure?
19. ____ Is each confined space checked for decaying vegetation or animal matter which may produce methane?

20. _____ Is the confined space checked for possible industrial waste which could contain toxic properties?
21. _____ If the confined space is below the ground and near areas where motor vehicles will be operating, is it possible for vehicle exhaust or carbon monoxide to enter the space?

Module 6 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. Which of the following should be considered the top priority in the Hierarchy of Control strategies?**
 - a. Substitution
 - b. Elimination
 - c. Engineering controls
 - d. Administrative controls

- 2. What is one of the most common hazard control methods to completely eliminate hazardous atmosphere in confined spaces?**
 - a. Open hatches
 - b. Respiratory protection
 - c. Forced-air ventilation of the space
 - d. Insertion of oxygen into the space

- 3. Which of the following eliminate or reduce the hazard through changes in the work practice?**
 - a. education controls
 - b. engineering controls
 - c. manufacturing controls
 - d. administrative controls

- 4. Which control strategy must be used if the hazard cannot be eliminated or reduced to a safe level through engineering and/or work practice controls?**
 - a. education controls
 - b. administrative
 - c. ergonomics controls
 - d. personal protective equipment

- 5. Welding, cutting, burning, and continuous brazing generate hazardous fumes and dusts that can be more effectively removed by _____ systems at or near the point of generation.**
- a. multiple point ventilation
 - b. remote exhaust ventilation
 - c. local exhaust ventilation
 - d. single point ventilation

Module 7: The Confined Space Entry Team

Management responsibilities

Your safety department will probably be responsible for developing the confined space program. Your line managers should always be responsible for deploying or implementing the program. Remember, safety is a line responsibility, not a staff support responsibility. Line and staff managers should:

- Ensure that a list of confined spaces is maintained,
- Ensure that canceled permits are reviewed for lessons learned,
- Ensure training of entry team members (authorized entrants, attendants, and entry supervisors) and other affected persons are conducted,
- Ensure coordination with outside emergency responders,
- Ensure personal protective equipment is in compliance with standards, and
- Maintain a master inventory of identified confined spaces.

Confined Space Entry Supervisor responsibilities

The Confined Space Entry Supervisor holds a key position with important responsibilities. This position is in charge of confined space work and should:

- Ensure requirements for entry have been completed before entry is authorized
- Authorizing entry and overseeing entry operations
- Ensure confined space monitoring is performed by personnel qualified and trained in confined space entry procedures
- Ensure a list of monitoring equipment and personnel qualified to operate the equipment is maintained by the employer
- Ensure that the rescue team has simulated a rescue in a confined space within the past twelve months
- Know the hazards that may be faced during entry, including the mode, signs or symptoms, and consequences of exposure
- Fill out a permit when it is required

- Determine the entry requirements and that conditions are acceptable for entry
- Notify all involved employees of the permit requirements
- Post the permit in a conspicuous location near the job
- Renew the permit or have it reissued as needed (a new permit is required every shift)
- Determine the number of attendants required to perform the work
- Perform duties as the confined space attendant if required
- Ensure the attendant knows how to communicate with the entrants and how to obtain assistance
- Ensuring measures are in place to keep unauthorized personnel clear of the area
- Post any required barriers and signs
- Remain alert to changing conditions that might affect the conditions of the permits, (i.e., require additional atmospheric monitoring or changes in personal protective equipment)
- Serving as an attendant, as long as the person is trained and equipped appropriately for that role
- Change and reissue the permit, or issue a new permit as necessary
- Ensure periodic atmospheric monitoring is done according to permit requirements
- Ensure that personnel doing the work and all support personnel adhere to permit requirements
- Ensure the permit is canceled when the work is done
- Ensure the confined space is safely closed and all workers are cleared from the area
- Checking the work at least twice a shift to verify and document permit requirements are being observed (more frequent checks should be made if operations or conditions are anticipated that could affect permit requirements)
- Ensuring that necessary information on chemical hazards is kept at the work site for the employees or rescue team

- Ensuring a rescue team is available and instructed in their rescue duties (e.g., an on-site team or a prearranged outside rescue service)
- Ensuring at least one member of the rescue team has current certification in first aid and CPR
- Terminating entry procedures as required

Confined Space Entrant responsibilities

Employees who are granted permission to enter a confined space should:

- Read and observe the entry permit requirements
- Stay alert to the hazards that could be encountered in a confined space
- Use the protective equipment required by the permit

Confined space entrants must immediately exit the confined space when:

- Ordered to do so by the attendant
- Automatic alarms sound
- They perceive they are in danger
- They notice physiological stresses or changes in themselves or co-workers (e.g., dizziness, blurred vision, shortness of breath).

Confined Space Attendant responsibilities

The Attendant should be stationed outside the work space and should:

- Be knowledgeable of, and be able to recognize potential confined space hazards;
- Maintain a sign-in/sign-out log with a count of all persons in the confined space and ensure all entrants sign in/sign-out;
- Monitor surrounding activities to ensure the safety of personnel;
- Maintain effective and continuous communication with personnel during confined space entry, work and exit;
- Order personnel to evacuate the confined space if he/she:

- Observes a condition which is not allowed on the entry permit;
- Notices the entrants acting strangely, possibly as a result of exposure to hazardous substances;
- Notices a situation outside the confined space which could endanger personnel;
- Notices within the confined space a hazard which has not been previously recognized or taken into consideration;
- Must leave his/her work station; or
- Must focus attention on the rescue of personnel in some other confined space that he/she is monitoring;
- Immediately summon the Rescue Team if crew rescue becomes necessary; and
- Keep unauthorized persons out of the confined space, order them out, or notify authorized personnel of the unauthorized entry.

Confined Space Rescue Team responsibilities?

The Rescue Team members should:

- Complete a training drill using mannequins or personnel in a simulation of the confined space prior to the issuance of an entry permit for any confined space and at least annually thereafter;
- Respond immediately to rescue calls from the Attendant or any other person recognizing a need for rescue from the confined space;
- In addition to emergency response training, receive the same training as that required of the authorized entrants; and
- Have current certification in first-aid and CPR.

Module 7 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

1. _____ are usually responsible for developing the confined space program and _____ are responsible to deploy or implement the confined space program.
 - a. Employees, safety managers
 - b. Safety staff personnel, line managers
 - c. Outside experts, safety supervisors
 - d. OSHA consultants, employees
2. Which of the following situations would require an immediate exit from the confined space?
 - a. automatic alarm sounds
 - b. ordered to exit the space by the attendant or supervisor
 - c. dizziness, blurred vision
 - d. all of the above
3. Who is responsible to maintain the confined space sign-in/sign-out log?
 - a. entry supervisor
 - b. recorder
 - c. authorized entrant
 - d. attendant
4. The confined space entry supervisor may also perform duties as the attendant during confined space operations.
 - a. true
 - b. false

5. The confined space rescue team must respond _____ to rescue calls from the Attendant.

- a. when available
- b. as soon as possible
- c. immediately
- d. within 4 minutes

Module 8: Confined Space Rescue

Introduction

Two-thirds of all confined space fatalities occur among would-be rescuers. To prevent deaths, it is critical to use good confined space entry practices so that there is no need for rescue operations. Remember, even a well-planned rescue can end up as a body retrieval. Rescues can be performed by any employee or a professional rescuer so long as he or she has been fully trained and qualified to act as a rescuer. Qualifications include knowledge of and experience working with all hazards associated with rescue and confined space entry operations.

Why confined spaces kill so many people

Confined spaces are deceiving. A confined space often appears to be harmless; no danger signs are apparent and the space may have been entered on prior occasions without incident. However, a worker cannot assume that conditions have not changed and that the space is safe for entry each time.

Confined space emergencies

A confined space emergency is any occurrence inside or outside the space, including failure of hazard control or monitoring equipment that may endanger authorized confined space entrants. Believe it or not, during emergencies, rescuers end up as confined space fatalities more often than those being rescued. So, why is that? Fatalities can occur when the rescuers:

- Are overcome by their emotions
- Take unnecessary chances
- Do not know the hazards involved
- Do not have a plan of action
- Lack confined space rescue training

It is important to know that the period of time for successful rescue is very limited. Otherwise, a rescue attempt will become body retrieval. After only four minutes without oxygen, it is very likely that a worker will experience asphyxiation, which may result in brain damage or death.

Preventing confined space rescuer fatalities

Planning the rescue is paramount. Make sure rescue team members understand their duties, and practice, practice, practice!

Ensure that the rescuer does not travel a greater distance than allowed by the air supply, self-contained breathing apparatus (SCBA), and escape cylinders. Analyze distance, space configurations, physical obstacles, and total time needed to enter the space, perform rescue operations, and leave the space. Leave the space immediately whenever a problem arises with respiratory protection equipment or whenever the attendant orders evacuation. Everyone involved in a rescue should assume that the space is deadly and that entry rescue may be required in the worst case!

Confined space rescue training topics

At a minimum, training must include:

- Recognition of permit space hazards.
- Control of permit space hazards.
- Use of atmospheric monitoring equipment.
- Use and maintenance of personal protective equipment (PPE).
- Use and maintenance of rescue equipment.
- Annual practice of permit space rescues.
- Proficiency in first aid and cardiopulmonary resuscitation (CPR).
- Documentation of training.

Three rescue strategies

Depending on the severity of the emergency, different rescue strategies or methods can be used. When the emergency is minor, self-rescue is often the best approach; however, if the worker is disabled, it is likely that non-entry or entry rescue may need to be used. Entry rescue involves putting others at risk, and should be used only if absolutely necessary.

1. Because of the speed at which confined space hazards can incapacitate and kill, self-rescue is the preferred plan. The self-rescue plan provides entrants with the best chance of escaping a permit space when hazards are present. Whenever authorized entrants recognize their own symptoms of exposure to a dangerous atmosphere, or when a prohibited condition is detected, entrants are still able to escape from the space unaided and as quickly as possible.

Self-rescue is vitally important because the entrant is:

- conscious and alert
 - able to recognize his or her own signs and symptoms
 - still physically able to evacuate space more rapidly than waiting for someone else to rescue him or her
 - able to alert fellow workers of impending dangers
 - not endangering anyone else
2. Non-entry rescue is the next-best approach when self-rescue is not possible because non-entry rescue can be started right away and prevents additional personnel from being exposed to unidentified and/or uncontrolled confined space hazards. Usually, equipment and other rescue aids are employed to assist in removing endangered entrants. In situations where configuration of the space or other elements prevent the removal of the worker, entry rescue may be the only solution.
3. Entry rescue involves rescuers entering the space to retrieve the entrant and/or provide the victim with emergency assistance such as CPR, first aid, and air via SCBA or a supplied air respirator (SAR), if needed. An entry rescue plan needs to be developed ahead of time in the event of an emergency for which the non-entry rescue plan is not appropriate.

Informing rescuers

It's important that rescuers are provided with vital information so that they can most effectively perform rescue operations. Rescuers will need to know:

- Number of victims and location of emergency.
- Length of time victims have been exposed to hazard.
- Suspected cause of accident.
- All information on entry permit, including:
 - Atmospheric testing results.
 - Isolation procedures.
 - Material Safety Data Sheet (MSDS) information.

The rescue plan

It's important to think through the rescue process proactively to make sure it is successful. Rescue plans may involve on-site rescue teams or they may rely on off-site rescue service providers. A thorough rescue plan includes:

- A barricade area for crowd control.
- Additional ventilation options.
- Control of other hazards (cave-ins, traffic, etc.).
- Protective clothing and equipment.
- Appropriate lighting equipment (explosion-proof).
- Methods of communication.
- A standby rescue team.
- Victim removal procedures and devices.
- Available emergency vehicles.
- Medically trained personnel.

Rescue Simulations

It's crucial that members of a rescue team practice simulated confined space rescues for each unique confined space at a facility. Rescue practices in simulated or actual spaces should be performed at least once every 12 months or more frequently if deemed necessary.

Re-evaluating rescue plans

Re-evaluate the plan whenever:

- Conditions change within the space.
- Workers discover any new hazards.
- There are changes in the rescue personnel and/or personnel availability.
- New equipment is purchased.
- Routine proficiency training results are unsatisfactory.

- A rescue plan is found to be deficient (e.g., a failed simulated rescue).

On-Site Rescue

Because most rescue service providers are unable to rescue within the four-minute time limit, most employers develop their own rescue teams. At least one on-site rescue team member should be trained in first aid and CPR.

Each member of the rescue team should be trained to:

- Properly use and maintain PPE and rescue equipment
- Act as a rescuer in annual simulated emergencies
- Assume individual roles and take on any emergency

Off-Site Rescue

Remember that while the window of opportunity for a rescue is very brief—only four minutes—the response time for an off-site rescue team may be considerably longer. After four minutes have lapsed, the victim could suffer brain damage or die. In some emergencies, rescuers may have even less than four minutes to act. Other situations may allow more time. To make sure your confined rescue plan is effective, make sure you:

- Arrange for local rescue/fire departments to provide rescue services.
- Supply the number and description of each permit required confined space in the facility ahead of time.
- Disclose all known hazards associated with the space(s) so that appropriate rescue plans can be developed.
- Provide access to the space so that off-site rescue personnel can familiarize themselves with the site, develop a rescue plan in advance, and practice rescue operations.

Verifying the availability of the off-site rescue service

If the employer relies on an off-site rescue service, the employer must contact the provider to verify they are available to conduct rescue operations if requested. The verification task is usually assigned to the entry supervisor. If the off-site rescue service indicates for any reason that it would be unable to respond to a rescue summons, entry must not be authorized unless and until an adequate back-up rescue service is arranged and confirmed.

Entry vs. Non-Entry

If the worker is physically able to use rescue equipment (safety retrieval line, rope, wristlets, etc.), rescuers may choose not to enter the space. Instead, they can provide appropriate equipment and assistance necessary to bring the worker out of the space (a non-entry rescue). In situations in which the worker is unresponsive, atmospheric hazards are extremely high, or significant time has elapsed before rescuers arrive at the site, emergency rescue personnel may decide that the risks associated with entering outweigh the potential for a successful rescue. If this is the case, rescuers may elect not to go into the confined space until conditions warrant a safe entry.

Non-entry rescue is the preferred method for confined space emergencies. It's important to remember that the confined space Attendant should not perform entry rescue. Rescue requiring entry should be performed by a trained rescue team or emergency service providers.

Rescue equipment

The importance of having the right rescue equipment on hand can't be stressed enough. Rescue equipment may include:

- Full body harness with retrieval line attached.
- Wristlets (may be used in rescue when it can be shown that they are the safest and most effective means of rescue).
- Hand-cranked mechanical winch and tripod (required when entrant is five feet or more below the entrance).
- Ladder.
- Explosion-proof lighting.
- SCBA/SAR.
- Stretcher.
- Approved head protection.

Using the full body harness and retrieval lines

All authorized entrants and rescuers entering permit spaces are required to use full body harnesses and retrieval lines, unless it is determined that the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue operation.

What kind of equipment should be used for lowering or lifting entrants?

Only devices designed by the manufacturer and approved for moving humans should be used. The equipment must enable a rescuer to remove the injured employee from the space quickly without injuring the rescuer or further harming the victim.

If there is even a remote possibility of other atmospheric contaminants, even though monitoring equipment readings appear to be within the normal ranges, rescuers should still use appropriate respiratory protection. Play it safe:

- Wear SCBA or SAR.
- Do not use air purifying respirators for confined space rescue.

Module 8 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. Rescues must be performed only by a professional rescuer who has been fully trained and qualified to act as a rescuer.**
 - a. true
 - b. false

- 2. Which of the following is not a common reason rescuers end up as confined space fatalities more often than entrants?**
 - a. they take unnecessary risks
 - b. they lack proper training
 - c. they do not know the hazards involved
 - d. they work too slowly

- 3. When self-rescue is not possible, which confined space rescue strategy is the next best for most emergencies?**
 - a. entry rescue
 - b. partial entry rescue
 - c. non-entry rescue
 - d. none of the above

- 4. A rescue attempt will likely become body retrieval after _____ without oxygen.**
 - a. 4 minutes
 - b. 8 minutes
 - c. 10 minutes
 - d. 20 minutes

- 5. What should the employer do if a rescue service provider is unable to rescue within the four-minute time limit?**
- a. rely on self-rescue
 - b. use a 911 service
 - c. develop a rescue team
 - d. hope the need does not arise

Module 9: Confined Space Training Requirements

Introduction

It's important that the employer provides training so that all employees who are required to perform confined space entry operations acquire the understanding, knowledge, and skills necessary for the safe performance of their duties in confined spaces.



Confined space training triggers

Training should be provided to each affected employee:

- before the employee is first assigned duties under this section
- whenever the employee demonstrates inadequate knowledge
- before there is a change in assigned duties
- whenever there is a change in permit space operations that presents a hazard for which an employee has not been trained
- whenever there are deviations from the permit space entry procedures

The training should establish employee proficiency in his or her confined space entry procedures and which task is being performed within the confined space.

General Training Topics

All employees who will enter confined spaces must be trained in entry procedures. Personnel responsible for supervising, planning, entering or participating in confined space entry and rescue must be trained in their duties prior to any confined space entry.

Training should include:

- Explanation of the general hazards associated with confined spaces;
- Discussion of specific confined space hazards associated with the facility, location or operation;
- Reason for, proper use, and limitations of PPE and other safety equipment required for entry into confined spaces;

- Explanation of permits and other procedural requirements for conducting a confined space entry;
- A clear understanding of what conditions would prohibit entry;
- How to respond to emergencies;
- Duties and responsibilities as a member of the confined space entry team; and
- Description of how to recognize (1) symptoms of overexposure to probable air contaminants in themselves and co-workers, and (2) methods for alerting attendants.

Refresher training should be conducted to maintain employee competence in entry procedures and precautions. If employees do not enter a confined space to perform work for an extended period of time (at least annually), they should be provided an opportunity to practice entry procedures.

Specific Training

Those entry team members who are responsible for monitoring confined space atmospheres should receive training on the proper use of monitoring and testing instruments. Training should include proper use of monitoring instruments such as:

- Proper use of the equipment;
- Knowledge of calibration;
- Knowledge of sampling strategies and techniques; and
- Knowledge of PELs, TLVs, LELs, UELs, etc.

Training for Attendants

Training should include the following:

- Procedures for summoning rescue or other emergency services, and
- Proper utilization of equipment used for communicating with entry and emergency/rescue personnel.

Training for Emergency Response Personnel

Training should include:

- Rescue plan and procedures developed for each type of confined space that are anticipated to be encountered
- Use of emergency rescue equipment
- First aid and CPR techniques
- Work location and confined space configuration to minimize response time

Verification of Training

Periodic assessment of the effectiveness of employee training should be conducted by a qualified person. Training sessions should be repeated as often as necessary to maintain an acceptable level of personnel competence.

- If confined space entry team members routinely work in confined spaces, refresher training may be brief.
- If confined space entry is rarely accomplished, team members should complete more comprehensive refresher training at least annually.

Make sure documentation of training verifies knowledge and skills. The training should include a written test and a practical demonstration requirement. The confined space entry team members should be able to "prove" they know what to do and how to do it. A competent person should certify the employees have demonstrated adequate knowledge and skills.

Module 9 Quiz

Use this quiz to self-check your understanding of the module content. You can also go online and take this quiz within the module. The online quiz provides the correct answer once submitted.

- 1. Which of the situations below would "trigger" the need for confined space training?**
 - a. upon initial assignment
 - b. a change in assigned duties
 - c. a demonstrated lack of knowledge
 - d. any of the above

- 2. Confined space training should establish employee proficiency in his or her _____ procedures and the _____ within the confined space.**
 - a. confined space designations, hazard to avoid
 - b. understanding of, dangers present
 - c. reporting, conditions that might develop
 - d. confined space entry, task being performed

- 3. Confined space entrants must know how to treat overexposure to air contaminants and methods for alerting Attendants.**
 - a. true
 - b. false

- 4. If confined space entry is rarely accomplished, team members should complete more comprehensive refresher training at least _____.**
 - a. once a year
 - b. once every six months
 - c. quarterly
 - d. every month

5. Confined space training should include which of the following?

- a. written test
- b. demonstration
- c. written test and demonstration
- d. written test or demonstration