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Introduction

The Center to Protect Workers Rights adopted this sixteen hour confined space program to enable it to teach major legal requirements of OSHA’s Permit-Required Confined Space Standard (29 CFR 1910.146). The Center’s main goal, however, is to ensure that members of the Building and Construction Trades understand what it is to work safely in confined spaces.

Every year hundreds workers in the United States die in confined space accidents and several thousand are seriously injured. Statistics compiled by the National Institute for Occupational Safety and Health (NIOSH) show that confined space accidents, more than any other type of workplace emergency, are likely to result in death.

One study by NIOSH found that about one-third of the fatalities in the incidents they investigated were would-be rescuers – individuals who tried to save a co-worker who was in trouble (see “Worker Deaths in Confined Spaces” by Ted A. Petit, et al, 1996). Perhaps a more meaningful statistic from Petit’s article is that only 40% of the employers involved in the NIOSH study had a written confined-space entry program and none had a confined-space entry permit system. According to NIOSH:

Most accidents involving workers in confined spaces are due to failure of site supervision to study the potential hazards and to provide appropriate safety and health programs; failure of supervisors to follow standard safety operating procedures and enforce regulations; and failure of workers to recognize and take appropriate action to avoid the effects of the hazards present.

(NIOSH Training Resource Manual, 1985)
The confined space training program and this manual are designed for building and construction trades members who work around, and may be required to enter, confined spaces. The program includes generic hands-on instruction for confined space entry and retrieval. If you will be either a confined space entrant or an attendant, your employer must provide additional site-specific training.

This confined space manual contains information on:

- the characteristics of confined spaces;
- the hazards and potential hazards of confined spaces;
- air monitoring, isolation, and ventilation, and safe entry procedures;
- personal protective and communications equipment for confined spaces;
- the duties of and training for entrants, attendants, and entry supervisors;
- safe entry and retrieval procedures; and
CONFINED SPACE ENTRY PROGRAM

Agenda

Day One

8:00 - 9:00 am  Program Overview & Introduction

9:00 - 10:45  Confined Spaces: Properties and Definitions
(w/break)  
  Chapter One
  O Small Group Activity: Staley Plant Accident
  H “Confined Spaces – Deadly Spaces”

10:45 - 12:00  Atmospheric Hazards of Confined Spaces
  Chapter Two
  O Q & A; Demo optional

12:00 - 12:30 pm  Lunch

12:30 - 1:45  Air Monitoring
(w/break)  
  Chapter Three
  I Small Group Activity: Monitoring Unknowns

1:45 - 2:20  PPE & Communications Equipment for CS Entry
  Chapter Four
  O Small Group Activity: PPE

2:20 - 4:20  Workshop: Supplied - Air Respirators
(w/break)  
  Č SCBAs
  Ń SARs

4:20 - 4:30  Day in Review/Q & A
Day Two

8:00 - 8:45 am
Using the NIOSH Pocket Guide
“NIOSH Pocket Guide”
○ Activity: Learning more about the Unknowns

8:45 - 9:45 am
Lockout/Tagout and Ventilation
Chapters Five & Six
○ Small Group Activity: Lockout/Tagout Plan
○ Small Group Activity: Preparing for a Confined Space Entry
   (Demonstration/Show & Tell)

9:45 - 10:20 am
Entrants, Attendants & Supervisors
Chapter Seven

10:20 - 11:30 am
The OSHA Entry-Permit System
Chapter Eight
○ Small Group Activity: Preparing an entry permit

11:30 - 12:00 am
Equipment for CS Entry and Retrieval
Chapter Nine
   (Demonstration/Show & Tell)

12:00 - 12:30 pm
Lunch

12:30 - 4:00 pm
Confined Space Entry Hands-on Simulation
   (w/break)

4:00 - 4:30 pm
Course Review & Evaluation
Each year in the United States, approximately 200 workers die in confined spaces; many more are seriously injured. Every single one of these deaths and injuries is preventable. Chapter One defines confined spaces according to their common properties and hazards. It also explains how the OSHA Permit-Required Confined Space Standard defines confined space.

All of the following are confined spaces with certain properties in common:

- storage tanks
- manholes
- pipes
- equipment rooms
- elevator shafts
- settling tanks
- utility vaults
- dip tank/degreaser
- tanker cars
- duct work
- plenums
- pits
- fan rooms
- silos
- trench

These confined spaces all share the following characteristics:

1. Limited Means of Entry/Exit
2. Not meant for continuous employee occupancy
3. Poor natural ventilation

Limited Means of Entry/Exit

Many confined spaces have only one opening. Openings are often small, awkwardly shaped or hard to get to. Some confined spaces, such as pits and excavations, may have large openings but they are difficult and dangerous to enter or exit. The limited entry/exit of confined spaces can make escape and rescue difficult.

Not Meant for Continuous Employee Occupancy

Usually, people enter confined spaces to inspect, repair, and clean the space itself, the equipment it contains, or to get access to another structure. A confined space may be entered every day for a limited period of time or it may be entered only a few times a year. But confined spaces are not designed for full-time, continuous worker occupancy.
EXAMPLES OF CONFINED SPACES
**Poor Natural Ventilation**

Most confined spaces have poor ventilation (and limited access) because they are designed to store, process, and transport materials. Confined spaces may house equipment (utility vaults) or provide access to equipment and structures. Some confined spaces, digesters for example, are made to be air-tight.

Poor ventilation can lead to low oxygen levels and high levels of gases and vapors.

The National Institute for Occupational Safety and Health (NIOSH) defines confined space by the three characteristics listed on Page 1. The OSHA Permit-Required Confined Space (PRCS) Standard has a different definition of confined space. The Confined Space Standard has a two-tier approach to confined spaces.

**OSHA’s Construction Standard 29 CFR 1926.21 (b)(6) requires that:**

All employees required to enter into confined or enclosed spaces shall be instructed as to the nature of the hazards involved, the necessary precautions to be taken, and in the use of protective and emergency equipment required. The employer shall comply with any specific regulations that apply to work in dangerous or potentially dangerous areas.

This standard then defines a confined or enclosed space for construction work:

...as any space having a limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere. Confined or enclosed spaces include, but are not limited to, storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, underground utility vaults, tunnels, pipelines, and open top spaces more than 4 feet in depth such as pits, tubs, vaults, and vessels.

**The General Industry Permit-Required Confined Space Standard** has a two-tier approach to confined spaces. According to OSHA 29 CFR 1910.146 (b), a confined space:

1. has limited or restricted openings for entry/exit;

2. is not meant for continuous employee occupancy; and
3. is large enough and shaped so an employee can get inside the space to perform assigned work

And according to OSHA 29 CFR 1910.146 (b), a permit-required confined space (permit space) is a confined space that also has at least one of the following hazards:

- hazardous atmosphere (or the potential for one)
- material that could engulf a person. The material could be stored in the space (for example, grain) or enter the space through pipes (such as water or chemicals)
- a shape that could trap or asphyxiate someone
- any other recognized serious safety or health hazard
- Other hazards which may exist in confined spaces include falling objects, slip, trip and fall hazards, sloping floors or converging walls, poor lighting, extreme heat or cold, electrical hazards, biological hazards, and any other hazard that will prevent a worker from self-rescue.

Recognizing Confined Spaces in Your Workplace

Confined spaces don’t always look dangerous. Because there are hundreds of different types of confined spaces, it may be hard to recognize that a particular space is a confined space. For example, settling tanks and excavations are confined spaces even though they are open on top. Engulfment accounts for thirty-four percent (34%) of confined space fatalities.

Fifty-six percent (56%) of all confined space deaths are due to atmospheric hazards. The trouble is that you can’t see atmospheric (air) hazards. You can’t see when there is too little oxygen or when there is too much oxygen in the air. You can’t see toxic or flammable gases/vapors that accumulate in confined spaces (except for very rare cases).

The potential hazards of confined spaces can become real hazards very quickly. Lack of ventilation can allow toxic gases/vapors to accumulate. Materials stored in the space or brought in by pipes can instantaneously engulf entrants. Energy sources which aren’t locked out can be turned on by people outside the space.

All potential hazards must be evaluated and controlled before work inside the space begins.
SMALL GROUP ACTIVITY

Hazards of Confined Spaces

On May 15, 1990, Jim Beals and Jerry Sumner, mechanics at the Staley corn processing plant in Decatur, Illinois, were ordered by a supervisor to make repairs on a cornstarch processing tank.

As Sumner tells the story, “This was a boilermaker’s job. None of us had ever done this job before, and we asked why a boilermaker wasn’t doing it. The supervisor said, ‘This vessel is as safe as can be. Just go in there.’”

“I got in the tank first. It was slimy inside. You had to worm your way in. The opening was only about 12” by 18”. It was round inside, so it was difficult to walk. We hadn’t been in there 15 minutes when all of a sudden a liquid started pouring in through an opening in the vessel. The stuff that came through was clear and there were no vapors. But then we started choking and realized it was propylene oxide. It took our breath away and we were suffocating. I told Beals I was getting the hell out of there. I just remember going toward the light. The next thing I knew I was outside the opening. I tried going back in for Jim but my eyes were burning too much. I stuck my head in the opening and yelled to him. He must have been gone by then. We tried to go in with a Scott air pack, but the opening was too small. We also found out later that there was almost no oxygen in the air pack. We also tried using emergency escape masks but we tried eight of them and none had any air in the bottles. Finally we tried using an air horn to blow air into the vessel, but you couldn’t stay near the opening, the fumes were too strong. My skin felt like it was on fire. I couldn’t wait any longer to get to the shower. But I kept saying to myself, ‘Jim’s dead, Jim’s dead.’"
1. In your small groups, make a list of all the problems that contributed to Jim Beals’ death.

After James Beals’ death, OSHA fined Staley $1.6 million and found 298 other health and safety violations. From *The Nation*, 5/17/1993.
BRIEF DESCRIPTION OF ACCIDENT

An employee sitting in a looped chain was lowered approximately 17 feet into a 21-foot deep manhole. Twenty seconds later he started gasping for air and fell from the chain seat down into the accumulated water at the bottom of the manhole. An autopsy determined oxygen deficiency as the cause of death.

ACCIDENT PREVENTION RECOMMENDATIONS

1. Instruct employees to recognize and avoid unsafe conditions associated with their work environment (29 CFR 1926.21 (b)(2)).

2. Instruction employees on hazards involved in entering confined or enclosed spaces (29 CFR 1926.21 (b)(6)(i) and (b)(6)(ii)).

3. Provide and require employees to use appropriate respiratory protection (29 CFR 1926.103 (a)(1) and 1910.134).

SOURCES OF HELP

- Construction Safety and Health Standards (OSHA 2207) which contains all OSHA job safety and health rules and regulations (1926 and 1910) covering construction.

- OSHA-funded free consultation services. Consult your telephone directory for the number of your local OSHA area or regional office for further assistance and advice (listed under U.S. Labor Department or under the state government section where states administer their own OSHA programs).

Fatal Facts issuances are intended to alert employers and workers in the construction industry to potential hazards. Although circumstances at an individual work site may not exactly match those described here, similarities often make it possible to identify hazards or dangerous work practices and correct them before injury or death occurs. OSHA encourages employers to discuss these cases with employees at tool box or similar regular safety meetings. Further, recipients are free to make and distribute additional copies of Fatal Facts (credit is requested but not required).

NOTE: The case here described was selected as being representative of fatalities caused by improper work practices. No special emphasis or priority is implied nor is the case necessarily a recent occurrence. The legal aspects of the incident have been resolved, and the case is now closed.
NOTES and SCRIBBLES
This section focuses on the atmospheric hazards of confined spaces:

- oxygen deficiency and oxygen enrichment
- flammable or explosive vapors and gases
- toxic vapors and gases

Fifty-six percent (56%) of all confined space deaths are caused by these atmospheric hazards.

**OXYGEN DEFICIENCY**  
29 CFR 1910.146 (b)

The air we breathe is approximately 21% oxygen, 78% nitrogen, and a 1% mixture of inert gases. **Air that contains less than 19.5% oxygen is considered oxygen deficient.**

When the concentration of oxygen in the atmosphere falls to 16%, most people will begin to breathe rapidly and feel confused. At 12% oxygen you begin to breath unevenly and may faint. When there is only 6% oxygen in the air, breathing stops and death occurs within minutes.

Most confined spaces have a potential for oxygen deficiency. **The only way to find out if the atmosphere in a confined space is oxygen deficient is to monitor the air.** Air monitoring is discussed in Chapter Four.

Whenever there is a potential for oxygen deficiency, only supplied air respirators that provide you with clean breathing air can be used. Chapter Six contains information on respirators for confined space entry.
### What Happens To Your Body If You Do Not Have Enough Oxygen?

<table>
<thead>
<tr>
<th>Amount of Oxygen</th>
<th>Results</th>
</tr>
</thead>
<tbody>
<tr>
<td>20.9%</td>
<td>You breathe normally</td>
</tr>
<tr>
<td>19.5%</td>
<td>OSHA minimum for safe entry</td>
</tr>
<tr>
<td>16%</td>
<td>Dizzy and confused</td>
</tr>
<tr>
<td>14%</td>
<td>Difficulty breathing</td>
</tr>
<tr>
<td>6%</td>
<td>Breathing stops, you may die within minutes w/o help</td>
</tr>
</tbody>
</table>
What Causes Oxygen Deficiency?

- purging a space and then ventilating it
- gases in the confined space can displace the oxygen in the air
- confined space work activities such as welding and scraping can “use up” oxygen
- chemical reactions such as rusting, decaying, fermentation or even the drying of certain paints and cements can also “use up” the oxygen

OXYGEN ENRICHMENT
29 CFR 1910.146 (b)

Sometimes the air in confined spaces contains too much oxygen. When the atmosphere is oxygen enriched, the risk of fire or explosion is increased. Flammable materials burn more violently and ignite more easily in oxygen enriched atmospheres.

The OSHA Permit-Required Confined Space Standard defines oxygen enrichment as an atmosphere with more than 23.5% oxygen.

Always use ordinary air to ventilate confined spaces. Never ventilate with pure oxygen. Ventilate with clean breathing air, even if the atmosphere is oxygen deficient. Adding oxygen can create a dangerous and flammable oxygen enriched atmosphere. For information on ventilation see Chapter Six.

Remember:

- Always monitor to find the oxygen content of the confined space.
- Do not operate heater or motors inside a confined space.
- Rust, drying paint, cement, or caulking can increase the chances of oxygen deficiency.
- Welding and burning inside confined spaces present major hazards and require special precautions as well as special hot work permits.
ACCIDENT SUMMARY

<table>
<thead>
<tr>
<th>Accident Type</th>
<th>Fire/explosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather</td>
<td>Fair and cold</td>
</tr>
<tr>
<td>Type of Operation</td>
<td>Installing water line</td>
</tr>
<tr>
<td>Crew Size</td>
<td>3</td>
</tr>
<tr>
<td>Collective Bargaining</td>
<td>Yes</td>
</tr>
<tr>
<td>Competent Safety Monitor on Site?</td>
<td>Yes</td>
</tr>
<tr>
<td>Safety and Health Program in Effect?</td>
<td>No</td>
</tr>
<tr>
<td>Was the Worksite Inspected Regularly?</td>
<td>Yes</td>
</tr>
<tr>
<td>Training and Education Provided?</td>
<td>No</td>
</tr>
<tr>
<td>Employee Job Title</td>
<td>Welder</td>
</tr>
<tr>
<td>Age/Sex</td>
<td>28/M</td>
</tr>
<tr>
<td>Experience at this Type of Work</td>
<td>2 years</td>
</tr>
<tr>
<td>Time on Project</td>
<td>2 months</td>
</tr>
</tbody>
</table>

BRIEF DESCRIPTION OF ACCIDENT

A welder entered a steel pipe (24" diameter) to grind a bad weld at a valve about 30' from the entry point. Before he entered, other crew members decided to add oxygen to the pipe near the bad weld. He had been grinding intermittently for about five minutes when a fire broke out enveloping his clothing. Another crew member pulled him 30' to the pipe entrance and extinguished the fire. However, the welder died the next day of his burns.

INSPECTION RESULTS

Following its inspection, OSHA issued three citations one willful, one serious and one repeat. Had the cited standards been followed, this fatality might have been prevented.

ACCIDENT PREVENTION RECOMMENDATIONS

1. Do not use oxygen for ventilation, cooling or cleaning in welding operations (29 CFR 1926.353 (a)(b)).
2. Comply with OSHA’s required confined or enclosed space entry program (29 CFR 1926.21 (b)(6)(i)).
3. Train employees to recognize and avoid unsafe conditions associated with their work and make sure they understand the confined space entry program and follow its procedures (29 CFR 1926.103 (b)(2)).

SOURCES OF HELP

- "Occupational Fatalities Related to fire and/or Explosion in Confined Spaces as Found in Reports of OSHA Fatality/Catastrophe Investigations," available from the National Technical Information Service, 5285 Port Royal Rd., Springfield, VA. 22161, (703) 587-5650, publication no. PB 82-237-314-, $13.00 pre-paid.
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**FLAMMABLE OR EXPLOSIVE GASES AND VAPORS**

Flammable gases and vapors can reach an explosive concentration in a confined space more rapidly than in an open area. Once there is an adequate concentration of a flammable gas/vapor in a confined space, a spark can ignite the fuel and cause an explosion.

On February 6, 1987, a father and son, on top of a digester being drained, opened a hatch to check the level of the sludge. To get light into the digester, they lowered an extension cord with an exposed 200 watt bulb through the hatch. The light broke, the methane gas in the digester exploded, and both men were killed instantly.

**Flammable and Combustible Chemicals**

Flashpoint is the temperature at which a liquid chemical gives off enough vapors to burn if there is a source of ignition. The lower the flashpoint the greater the fire hazard.

Liquid chemicals with **flashpoints below 100° F are called flammable.** They are high fire risks.

Liquid chemicals with **flashpoints between 100° F and 200° F are called combustible.** They present moderate risk of fire.

Chemicals with **flashpoints above 200° F are considered low fire risks.**
Here’s an example
- Gasoline has a flashpoint of -45°F
- Kerosene has a flashpoint of 100°F to 162°F
- Lubricating oil has a flashpoint of 300°F to 450°F

Question:
1. Which of the three chemicals is flammable? Which is combustible?
2. Which chemical is a low fire risk?

Write down your answers:
1. 
2. 

Remember:
Flashpoint is used for liquid chemicals only. It is the temperature at which the liquid gives off enough vapors for them to burn if there is a source of ignition.

Flammable/Explosive Atmospheres in Confined Spaces

Upper and Lower Explosive Limits

Flammable gases and vapors must reach a certain concentration in the air in order for them to burn. The minimum concentration of a flammable gas/vapor in the air which is needed for a fire or explosion is called the LOWER EXPLOSIVE LIMIT or LEL. (It is also called the Lower Flammable Limit or LFL.) Employees must immediately leave a work area when monitoring detects an LEL of 10% or more.

Above the LEL the air/chemical mixture will burn if there is a source of ignition. The air/chemical mixture is “just right” for a fire until the concentration of the chemical in the air reaches the UPPER EXPLOSIVE LIMIT (UEL). The UEL is the maximum concentration of a flammable gas/vapor in the air which will burn. (Also called the Upper Flammable Limit or UFL.) Above the UEL there is too much chemical in the air; the air/chemical mixture is too rich to burn. When the mixture is too rich to burn there usually isn’t enough oxygen for there to be a fire.

- The LEL and the UEL are generally expressed as percentages. For example, the LEL for benzene is 1.2%.
When benzene vapors make up 1.2% of the atmosphere and there is a spark, the air/benzene mixture will burn.

- The UEL for benzene is 7.8%. When benzene vapors are more than 7.8% of the atmosphere, the air/benzene mixture is too rich (not enough oxygen) to burn.

The explosive or flammable range of a chemical is between the LEL and the UEL. Within the explosive/flammable range, the chemical/air mixture will burn if there is a source of ignition.

The wider the explosive or flammable range the more hazardous the chemical.

**Here’s an example**
- The LEL for gasoline is 1.4%, the UEL is 7.6%
- The LEL for MEK (methyl ethyl ketone), a common solvent, is 1.4%, the UEL is 11.4%

**Questions:**
Which chemical, gasoline or MEK, has the greater flammable range? Based only on the flammable range, which chemical is more hazardous?

**Check your answers:**
MEK is more hazardous. It has a greater flammable range.
How Can You Tell the Concentration of a Flammable Gas/Vapor in a Confined Space?

The only way to find the concentration of a flammable gas/vapor is to use an air monitor. LEL meters show you how close to the LEL the concentration of a flammable gas/vapor is. Monitoring is discussed in Chapter Three.

**Remember, never assume a confined space is safe.** Never rely on your sense of smell to detect chemicals. Always use non-sparking tools and intrinsically safe equipment (electrical or electronic tools and monitors that won’t provide a source of ignition) so you do not provide the source of ignition that could start a fire.

**Vapor Density**

**Vapor Density** is another characteristic of gases and vapors which can provide clues to atmospheric hazards in confined spaces. Knowing the vapor density of a chemical is especially important when you monitor for toxic or flammable gases/vapors.

Air has a vapor density of one (1). A gas or vapor that is heavier than air will have a vapor density greater than one. A gas or vapor that is lighter than air will have a vapor density between zero and one.

Chemicals with vapor densities greater than one tend to sink toward the ground. Gases and vapors lighter than air tend to rise toward the ceiling. Gases and vapors with densities around one mix in evenly with air.

![Diagram of vapors rising and sinking based on density]

Vapors which are lighter than air will rise to the top.

Vapors which are heavier than air will sink to the bottom.
Here’s a vapor density example
- Toluene has a vapor density of approximately 3.0
- Carbon monoxide has a vapor density of 0.97
- Ammonia has a vapor density of 0.59

Question 1:
Which of the three chemicals is most likely to sink toward the ground?

Question 2:
Which of the three chemicals is most likely to rise toward the top?

Write down your answers:
1. 
2. 

Knowing the vapor density of the gas/vapor in the confined space tells you where to monitor and where the most hazardous atmosphere is likely to be.

Toxic Atmospheres

Toxic gases, vapors, dusts and fumes in a confined space can make the atmosphere toxic (poisonous). Many chemicals can cause serious health effects at very low concentrations. Flammable and non-combustible gases, vapors, dusts and fumes can be toxic. In confined spaces, a toxic chemical is likely to harm you at a level well below the LEL.

For example:

Hydrogen sulfide (sewer gas or swamp gas) can be found in industrial sewers. The LEL for hydrogen sulfide is 4.0%, which is the same as 40,000 parts per million (ppm).

If you were exposed to only 500 ppm of hydrogen sulfide for 30 minutes you could suffer headache, diarrhea, dizziness, staggering gait, respiratory distress. At 1,000 ppm (well below the LEL of 40,000 ppm) the nerves that control breathing are paralyzed and death occurs in minutes. Hydrogen sulfide’s IDLH is 100 ppm.
Here’s another example:

Carbon monoxide is an invisible, odorless, flammable gas produced by boilers, engines, motors, heaters, etc. It is deadly. **Carbon monoxide asphyxiates you by replacing the oxygen in your blood.**

The LEL for carbon monoxide is 12.5% or 125,000 ppm. But, headache, clumsiness, nausea can begin at **400-800 ppm**. Its **IDLH is 1200 ppm**.

Consider this story:

Two millwrights entered an unventilated sewer to repair a gasoline-powered pump. The employer had no confined space entry program. No monitoring was done; there was no rescue equipment. One millwright was overcome by carbon monoxide and died. The other managed to escape from the sewer and called the fire department for help. A “passerby” tried to rescue the millwright who was down in the sewer. The passerby died. Thirty firefighters and eight co-workers were treated for carbon monoxide poisoning resulting from this single incident.

Confined spaces with more than 35 ppm of carbon monoxide should not be entered until they have been properly ventilated.

O  The vapor density of carbon monoxide is approximately 0.97.

**Question:** Where within a confined space would you expect to find carbon monoxide?

**Write down your answer:**

In confined space work, the acute (immediate) rather than the chronic (long-term) health effects of exposure to toxic substances are the main concern. For example, the acute effects of exposure to solvents such as toluene, xylene, and methylene chloride include confusion, lack of coordination, and drowsiness. All of these seriously impair your ability to function and escape from a confined space.

Many acute health effects disappear when exposure to the chemical stops. However, **damage from acute exposure can be permanent**. Most toxic chemicals can, with long-term low-dose exposure, also cause chronic health effects which may not show up for many years. For the solvents
mentioned above, the health effects caused by chronic exposure include liver damage, central nervous system damage, reproductive effects and for methylene chloride, cancer.

To reduce the possibility of exposure to toxic chemicals in confined spaces, you may need to use personal protective equipment (PPE). PPE is discussed in Chapter Four.

Below is a list of some of the more common chemicals found in confined spaces.

- **methane** – decreases oxygen content and a flammable gas
  Sources/uses: occurs in natural gas, produced by decomposition of organic matter; used in production of ammonia and other chemicals

- **hydrogen sulfide** – a toxic and flammable gas.
  Sources/uses: by-product of many industrial processes, sewers, and collected garbage; found where petroleum products are processed, stored, used; occurs in coal, natural gas, oil, decaying organic matter

- **acetylene** – decreases oxygen and is flammable
  Sources/uses: used for welding, cutting metals, and in the production of vinyl chloride and other chemicals

- **carbon monoxide** – decreases oxygen content
  Source: by-product of combustion in the confined space or migration into the space from an outside source

- **gasoline** – is toxic and flammable
  gasoline and related hydrocarbons are found in refinery work, and can also drift/leak into below ground confined spaces

- **solvents** – most, solvents are both flammable and toxic: common solvents include Stoddard solvent (mineral spirits), methylene chloride, toluene, MEK, thinners (for paint, varnish, lacquer)

- **residues of chemicals** that were stored or processed in the confined space: may include acids and bases, solvents and intermediate chemicals (“stepping stones” in the production of chemical products; i.e.: benzene, toluene, naphthalene, etc.)

- **chemicals that migrate** into confined spaces or may be stored in the space: such as gasoline, pesticides, and PCBs
OTHER DANGERS OF CONFINED SPACES

Bacteria & Viruses
Industrial sewers and waste water treatment facilities may have bacteria, viruses, fungi and parasites that can affect you and your family. The bacteria can include salmonella (usually contracted from food poisoning). Flu viruses, as well as Hepatitis A, may also be in waste water.

Engulfment
Grain, coal, gravel, etc. can engulf (bury) people working in confined space. Liquids can drown entrants.

Electricity
Following strict lockout procedures while working in confined spaces is essential. Machinery and equipment which is turned off only at the switch, but still energized, can be turned on by someone outside the confined space. All power sources must be shut off and locked out at the source. Lockout/ tagout is discussed in Chapter Five.

Falling Objects
It is very important to guard top-hatch openings into confined spaces to prevent objects falling into the space.

Heat and Cold
Confined spaces have poor natural ventilation and are not intended for continuous occupancy. It is common for them to have very uncomfortable temperatures. Heat can lead to fatigue and at extremes may even contribute to oxygen deficiency. Cold can affect your muscular coordination.

Slips, Trips and Falls
Many confined spaces have dangerous shapes. Walls and floors may slope, converge, tilt or curve. Residues can make surfaces slippery. Most confined spaces do not have secure hand or foot holds. A harness and lifeline can protect you from slip, trip, and fall hazards in confined spaces. (See Chapter Nine for information on rescue/retrieval equipment.)

Noise
Noise can interfere with your ability to hear and to make yourself heard. If it is noisy you may not be able to hear sounds that could warn you that something is wrong. Noise is also stressful to the body and can produce a sense of isolation.
SUMMARY

Fifty-six percent (56%) of confined space deaths are due to atmospheric hazards. These include:

- Concentration of a flammable gas, vapor, or mist that is above ten percent (10%) of its LEL (Lower Explosive Limit);

- Concentration of a combustible dust at or above the LEL (roughly, the concentration which obscures vision at five feet or less);

- Oxygen concentration below 19.5% or above 23.5%;

- Concentration of any substance for which a PEL (or dose) is listed in either OSHA Subparts G or Z, that is above the listed exposure limit; and

- Any other atmospheric condition that is IDLH (Immediately Dangerous to Life or Health).
BRIEF DESCRIPTION OF ACCIDENT

Two employees were welding brackets onto an oil storage tank (55,000 gallons). The tank, half full, contained explosive atmospheres of vapor from waste chemical and oil materials from automobile and truck service stations. One worker was killed and the other injured when the tank exploded and the top was blown off.

INSPECTION RESULTS

As a result of its investigation, OSHA issued citations for violations of four standards.

ACCIDENT PREVENTION RECOMMENDATIONS

1. The employer must instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment "to control or eliminate any hazards (29 CFR 1926.353 (b)(2).

2. The employer is responsible for requiring the wearing of appropriate personal protective equipment in all operations where there is an exposure to hazardous conditions (29 CFR 1926.28 (a). In this case, safety belts and lanyards or other means of fall protection would have prevented employees from falling off the tank to the ground. Also, fire and heat resistant safety clothing should have been provided and used.

3. Welding, cutting, or heating must not be done where the application of flammable paints, or the presence of other flammable compounds, or heavy dust concentrations creates a hazard. (29 CFR 1926.352 (c).

4. Drums, containers, or hollow structures which have contained toxic or flammable substances must be filled with water or cleaned of such substances and ventilated and tested before welding, cutting, or heating is undertaken on them (29 CFR 1926.352 (i).

SOURCES OF HELP


- OSHA-funded free consultation services listed in telephone directories under U.S. Labor Department or under the state government section where states administer their own OSHA programs.

- Courses in construction safety are offered by the OSHA Training Institute, 1555 Times Drive, Des Plaines, IL 60018, 312/297-4810.

NOTE: The case here described was selected as being representative of fatalities caused by improper work practices. No special emphasis or priority is implied nor is the case necessarily a recent occurrence. The legal aspects of the incident have been resolved, and the case is now closed.
This chapter explains air monitoring for confined space entry. You will not be doing confined space monitoring; however, as the entrant you must be able to determine that initial monitoring has been done, that it has done properly with currently calibrated monitors, and that while you are in the space that it is, again, being done properly. The following topics are covered in this chapter:

- what to monitor for
- the order to follow when monitoring
- monitoring before and during confined space entry
- different types of air monitors
- parts of an air monitor
- intrinsically safe instruments

Most deaths in confined spaces occur because the air isn’t tested or the air monitor isn’t used properly. Workers enter spaces where they may encounter too little or too much oxygen as well as flammable or toxic gases and vapors. **Before entering any confined space, monitor the atmosphere, ventilate if necessary, and continue monitoring to make sure the air remains safe.** Monitoring revisions made in 1998 to 29CFR1910.146 are projected to save up to fifty-five lives a year.

**WHAT TO MONITOR IN A CONFINED SPACE**

29 CFR 1910.146 (b)

The **three (3) atmospheric hazards** of confined spaces are:

- too little or too much oxygen (oxygen deficiency or enrichment)
- explosive gases, vapors, and dust
- toxic gases and vapors

The acceptable levels of each are:

- **Oxygen**: between 19.5-23.5%
- **Explosive gases or vapors**: less than 10% of the Lower Explosive Limit (LEL); airborne combustible dust below the LEL
- **Toxic gases or vapors**: below OSHA’s Permissible Exposure Limit (PEL)
Never Rely on Your Sense of Smell to Detect Gases and Vapors.

- Your nose can’t tell the amount of oxygen in the air. Oxygen is an odorless, colorless, and tasteless gas. Many other gases and vapors are also odorless. Carbon monoxide is odorless and toxic. Nitrogen and carbon dioxide are odorless and can replace the oxygen in the air. Hydrogen is odorless and can explode with a single spark.

- Don’t rely on odors to warn you of toxic exposures. Some gases and vapors with good warning properties can be smelled below the level where they cause harm. But many gases and vapors have poor warning properties and can’t be smelled until they reach harmful levels. Certain chemicals can deaden your sense of smell so that you stop being able to smell them. For example, hydrogen sulfide at low levels smells like rotten eggs. At higher amounts, hydrogen sulfide deadens your sense of smell so that you can’t smell it at an exposure level which could kill you. The ability to smell varies throughout the population. Many people have a poor sense of smell and may not even be able to detect a chemical that has great warning properties.

DIRECT-READING INSTRUMENTS

The air monitors used to test the air in confined spaces are called direct-reading instruments. They “read” an air sample and give you an answer quickly. Air monitors test for oxygen. They also test for explosive and toxic gases and vapors. Only a few gases and vapors can be specifically detected. Chemical specific sensors are currently available for the following compounds:

- oxygen
- carbon monoxide
- chlorine
- hydrogen
- ammonia
- hydrogen sulfide
- hydrogen cyanide
- nitrogen oxide
- sulfur dioxide
- ozone

If you know that the confined space contains one of the chemicals listed above, you can use a sensor to detect that chemical. But, a hydrogen sulfide sensor will not detect solvent vapors from thinners or glues. If you are dealing with unknown chemicals it is better to use a non-specific sensor which is sensitive to small amounts of toxic gases and vapors.
ORDER OF AIR MONITORING

Always monitor a confined space in the following order:

1. oxygen
2. explosive gases and vapors
3. toxic gases and vapors

Oxygen must always be sampled first. If there is not enough oxygen, your reading for explosive gases and vapors may be inaccurate. When the air contains less than 15% oxygen, the reading for explosive gases/vapors may be falsely low. You must test for oxygen first in order to know if the LEL reading is accurate. If the sensor doesn’t register, do not enter the space. Oxygen content may be very low.

A confined space can have enough oxygen, be safely below 10% of the LEL, but still be hazardous to your health. Some chemicals can cause health effects at very low levels. It is always important to test for toxic gases and vapors.

HOW TO MONITOR IN A CONFINED SPACE

Always monitor the inside of a confined space from outside the space. Collect the air sample through a sampling probe inserted into the space. A probe is a long, hollow, narrow tube connected to the inlet of the monitor. To obtain a sample, keep the cover to the space closed. This keeps hazardous air inside the space and prevents it from mixing with the outside air.

Begin monitoring the confined space from the outside with the cover to the space still in place.
Some air monitors draw a sample with a motorized or hand-activated pump. Others allow the air to passively move across the sensor (passive diffusion).

Passive diffusion monitors may have to be lowered into the confined space if they don’t have sampling lines and probes.

If initial testing shows the air is within safe limits, remove the cover to the space and begin **sampling vertically every four feet**. Some monitors take a long time to respond fully. To be safe, **allow at least two to three minutes for a full response**. The vapor density of a chemical generally determines where it can be found in a confined space. Sampling every four feet ensures that you will detect all the gases and vapors which accumulate at different levels within the space.

To help direct the sampling probe, attach it to a long, sturdy pole. Sample each **vertical layer horizontally within a radius of six feet (space permitting)**. Monitor slowly, carefully, and completely! The air within a confined space may be unevenly mixed. Hazardous gases may exist within several feet of an area that reads safe.

Since the air within a confined space can change quickly, it is recommended that you monitor continuously while you are in the space. Remember, sensors in direct-reading monitors take time to respond fully. When sampling air through more than 10 feet of sample line, the instrument needs more time to respond.

Monitors can be worn on a belt or in an outside shirt or pocket. If possible, tubing should be near the entrant’s breathing zone to measure the content of the air the entrant is actually breathing.
TYPES OF DIRECT-READING AIR MONITORS

Direct-reading air monitors contain several types of sensors to measure the air. Three types of sensors used in air monitors are:

- **Electrochemical Cells**
  Electrochemical cells detect oxygen and a small number of other specific chemicals, including carbon monoxide and hydrogen sulfide. They may respond to gases for which they were not intended, resulting in false readings.

- **Combustible Gas Sensors**
  Combustible gas sensors are non-specific detectors that measure the total amount of explosive gas as a percentage of the lower explosive limit (LEL). Combustible gas sensors are used in “LEL meters.”

- **Broad-Band Sensors**
  Broad-band sensors are non-specific detectors which respond to explosive and toxic gases and vapors. These sensors are good screening tools for detecting toxic chemicals in confined spaces.

Four gas (O₂, Comb, CO, H₂S) direct reading monitor with optional top-mounted pump and required rear battery pack with recharging port. Monitor has audio and visual alarms and port for earjack.

Exploded view showing battery (top right), pump (bottom right), main unit w/4 sensors (O₂-bottom left, Comb-middle left, CO-top left, and H₂S-top right), and cover plate.
Detector Tubes

Detector tubes, which can measure approximately 200 different substances, can be used to detect the presence of toxic gases/vapors in confined spaces. To use a detector tube you must know the gas or vapor that you are testing for.

If you use detector tubes to sample a confined space, always check the following:

- the right tube is used for the chemical being sampled
- the tube has not expired
- both ends of the tube are broken before use
- the sample pump passes a leak test
- the correct amount of air is drawn for each sample
- the air sample is collected from where entrants will be working in the space

The accuracy of detector tubes, which can be “off” by as much as 25%, is affected by temperature, humidity, pressure, and the presence of other chemicals.
PARTS OF AN AIR MONITOR AND HOW TO CHECK THEM

In addition to the sensor or detector, direct-reading air monitors contain some or all of the following parts:

Alarm

Monitors should be equipped with both audible and visual alarms to warn you of a hazardous atmosphere. The alarm points should be set at 19.5% and 23.5% for oxygen, 10% for the LEL, and the amount of the PELs or Threshold Limit Values (TLV) in parts per million for the specific chemical sensors.

A “locked on” alarm is intended to sound continuously, even if you move out of the hazardous atmosphere into a safe area. Some monitors have alarms which can only be turned off by shutting the instrument off and then turning it back on. (Pushing the reset button alone is not enough to turn the alarm off.)

Always turn the air monitor off and on in a safe and clean atmosphere, away from the confined space.

Power Supply/Battery Indicator

Air monitors should be equipped with battery indicators. Some instruments will indicate battery strength on start-up. Some monitors will turn on an alarm when the power supply drops below a certain point. This indicates it is time to change the batteries or recharge the battery unit.

Checking the battery seems pretty obvious. Yet this simple procedure is often skipped. One Building and Construction Trades member told of working in a trench where he smelled chemicals. When he mentioned it, he was told by the person monitoring the air that the monitor read zero. It turned out that the battery was dead and the instrument wasn’t even operating! Always check the battery and find out how long it can hold a charge. This is essential for confined space work.

Sampling Pump

Two kinds of sampling pumps are used with air monitors; hand pumps and motor-driven pumps. Always check the sampling pump on an air monitor before using it.Leaks affect the accuracy of the reading because the pump will not draw enough air for a sample.

Hand pumps draw an air sample with an oval-shaped, rubber squeeze bulb. The bulb should be capable of holding a vacuum when fully squeezed. Never use a
cracked or taped bulb. Squeeze bulbs require a lot of contractions to draw a sample through several feet of sample line, and can quickly cause hand fatigue.

To check whether a motorized sampling pump is working, briefly hold your thumb over the opening to the sample port. You should hear the motor strain under the load. Some instruments will shut off and sound an alarm if the strain on the pump is great enough. Other instruments use a visual indicator, such as a floating ball, to show that air is moving through the instrument. When the sample port in the instrument is blocked, the ball will flutter indicating a strain on the sampling pump.

**Calibrating Air Monitors**

Before an air monitor is used, it must be properly calibrated. Ask the person monitoring the confined space when the instrument was last calibrated. Monitors should be bench calibrated at least once every six months. (Bench calibration is done in the factory or by a certified person.) The date of this bench calibration should be marked on the outside of the instrument.

Before an instrument is used to monitor a confined space it should be checked with special calibration gas. If a monitor is used for eight hours or longer it may need to be field calibrated more than once during the day. Always ask the person monitoring the confined space when the instrument was last field calibrated.

**INTRINSIC SAFETY**

If a confined space contains explosive gases or vapors, any spark can set off an explosion. **Intrinsically safe electrical and/or electronic equipment** will not provide that spark. All such equipment used in areas that contain gases and vapors, particles and dusts, and fibers should be intrinsically safe. Air monitors used in confined spaces that contain hazardous gases and vapors should be certified for Class I, Division 1 and 2, Group A. This category covers all explosive gases and vapors, even acetylene which is the most flammable. Non-sparking tools such as wrenches, hammers, and screw drivers must also be used.
SUMMARY

Never enter a confined space before it is monitored. Always monitor a confined space in this order:

1. Oxygen
   Oxygen content should be between 19.5% and 23.5%.

2. Explosive gases/vapors
   Concentration of explosive gases/vapors should be below 10% of the LEL.

3. Toxic gases/vapors
   Concentration of toxic gases/vapors should be below the OSHA Permissible Exposure Limit (PEL).

Confined spaces should be monitored continuously when an entrant is inside.
ACCIDENT SUMMARY

<table>
<thead>
<tr>
<th>Accident Type</th>
<th>Explosion</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather</td>
<td>Clear</td>
</tr>
<tr>
<td>Type of Operation</td>
<td>Construction</td>
</tr>
<tr>
<td>Crew Size</td>
<td>2</td>
</tr>
<tr>
<td>Competent Person on Site?</td>
<td>Yes</td>
</tr>
<tr>
<td>Safety and Health Program in Effect?</td>
<td>Yes</td>
</tr>
<tr>
<td>Was the Work site Inspected Regularly by the Employer?</td>
<td>Yes</td>
</tr>
<tr>
<td>Training and Education Provided?</td>
<td>Yes</td>
</tr>
<tr>
<td>Employee Job Title</td>
<td>Iron worker</td>
</tr>
<tr>
<td>Age/sex</td>
<td>45/M</td>
</tr>
<tr>
<td>Experience at this Type of Work</td>
<td>20 years</td>
</tr>
<tr>
<td>Time on Project</td>
<td>2 hours</td>
</tr>
</tbody>
</table>

BRIEF DESCRIPTION OF ACCIDENT

Propane gas was being used to fuel a portable heater (blow torch). The torch flamed out, allowing gas to gather in the bilge area of a construction barge. The accumulated gas exploded with great force, killing the worker.

INSPECTION RESULTS

As a result of its investigation, OSHA issued citations for two serious violations of OSHA standards.

ACCIDENT PREVENTION RECOMMENDATIONS

The employer must:

1. Take precautions to provide sufficient ventilation to ensure proper combustion when operating portable heaters/blow torches in confined spaces, in accordance with 29 CFR 1926.154 (a)(2)

2. Ensure that portable heaters/blow torches are equipped with automatic shut-off devices to stop the flow of gas in the event of flame failure, in accordance with 29 CFR 1926.153(h)(8).

SOURCES OF HELP


- OSHA-funded free consultation services listed in telephone directories under U.S. Labor Department or under the state government section where states administer their own OSHA programs.

- OSHA Safety and Health Training Guidelines for Construction, Volume III (Available from the National Technical Information Service, 5285 Port Royal Road, Springfield, VA 22161; phone (703) 487-4650; Order No. PB-239-312/AS; Cost $25.) to help construction employers establish a training program.

- Courses in construction safety are offered by the OSHA Training Institute, 1555 Times Drive, Des Plaines, IL 60018; phone (847) 297-4810.

- OSHA regulations, documents and technical information also are available on CD-ROM, which may be purchased from the Government Printing Office, phone (202) 512-1800 or fax (202) 512-2250, order number 729-13-00000-5; cost $43 annually; $17 quarterly.

Note: The case described was selected as being representative of fatalities caused by improper work practices. No special emphasis or priority is implied nor is the case necessarily a recent occurrence. The legal aspects of the incident have been resolved, and the case is now closed. Your company may duplicate this leaflet to share with your co-workers.
Understanding the NIOSH Pocket Guide to Chemical Hazards

The January 2003 464 page *NIOSH Pocket Guide* containing 667 chemicals, thirty-four pages of introduction, Appendices A-G, and three indices has a green cover that looks like ...

![NIOSH Pocket Guide Cover]

Chemicals are listed alphabetically, four to a two-page flat. On the next page are the two *Pocket Guide* pages containing the chemical Toluene.

While this learning guide stands alone, it works best when used with your copy of the *NIOSH Pocket Guide*. 
## Chemical Name, Structure/Formula, CAS and RTECS numbers, and DOT ID and guide numbers

<table>
<thead>
<tr>
<th>Chemical name, structure/formula, CAS and RTECS numbers, and DOT ID and guide numbers</th>
<th>Synonyms, trade names, and conversion factors</th>
<th>Exposure limits (TWA unless noted otherwise)</th>
<th>IDLH</th>
<th>Physical description</th>
<th>Chemical and physical properties</th>
<th>Incompatibilities and reactivities</th>
<th>Measurement methods (see Table 1)</th>
</tr>
</thead>
</table>

### Titanium dioxide
- **TiO₂**
- **Titanium oxide Titanium peroxide**
- **NIOSH Ca** See Appendix A
- **OSHA**
- **Sp.Gr.: 4.26**

#### Physical description:
- **White, odorless powder**
- **MW: 79.9**
- **FLP: 4522-542-7**
- **Sel: Insoluble in H₂O**
- **IP: N/A**
- **Sp.Gr.: 4.26**

#### Incompatibilities and reactivities:
- **None reported**
- **NIOSH S285 (II-3)**

### 0-Tolidine
- **C₆H₄(NH₂)₂**
- **119-93-7**
- **DO1225000**

#### Physical description:
- **4,4'-Diamino-3,3'-dimethyl-biphenyl**
- **Diaminotoluene**
- **TDA**
- **Diaminoditolyl**
- **4,4'-Diamino-3,3'-Dimethylbenzidine**

#### Incompatibilities and reactivities:
- **Strong oxidizers**
- **OSHA 5013**

### Toluene
- **C₈H₈**
- **H8-3**
- **XS250000**
- **1294 130**

#### Physical description:
- **Colorless liquid with a sweet, pungent, benzene-like odor.**
- **MW: 92.1**
- **BP: 232°F**
- **SOL: 4.0°F**
- **SP.GR: 0.67**

#### Incompatibilities and reactivities:
- **None reported**
- **OSHA1500**
- **1501, 3800, 4000; OSHA111**

### Toluenediamine
- **CH₂(CH₃)(NH₂)₂**
- **25376-45-8**
- **95-40-7**
- **(2,4-TDA)**
- **NX9445000**
- **NX6250000**
- **1709 151**

#### Physical description:
- **Colorless to brown, needle-shaped crystals or powder.**
- **MW: 122.2**
- **BP: 558°F**
- **SOL: 4.0°F**
- **Sp.Gr: 0.67**

#### Incompatibilities and reactivities:
- **None reported**
- **OSHA 5516; OSHA 65**

## Pages 310-311

### Personal protection and sanitation (See Table 2)

### Recommendations for respirator selection—maximum use concentration (MUC) (See Tables 3 and 4)

### First aid (See Table 5)

### Health hazards—exposure routes (ER) symptoms (SY), target organs (TO) (See Table 6)

### Skin:
- **NR**
- **N.R.**
- **Daily**
- **Remove:**

### Eyes:
- **Prevent eye contact**
- **Wash when:**
- **Removes:**

### Respiratory:
- **Prevent skin contact**
- **Wash when:**
- **Removes:**

### Titanium dioxide

### Toluene

### Toluenediamine

Toluene

C₆H₅CH₃

108-88-3
XS5250000
1294 130

The each two-page flat of four chemicals has thirteen columns, starting on the far left. The first column is titled: Chemical name, structural formula, CAS and RTECS Nos., and DOT ID and guide Nos. Toluene is the third chemical from the top, or second chemical from the bottom, beginning on page 310. The first column has four lines of information about toluene (see box at left).

If we focus on the CAS number 108-88-3, we can utilize the CAS Number Index at the back of the *Pocket Guide*. If you come across a barrel at your work site without a label and marked only with a CAS number, you can then check the number using your CAS Number Index. On page 375 of the *Pocket Guide*, you will find the column reproduced to the right. You see from the information in the column that you are to turn to page 310 of the *Pocket Guide* to find the chemical with the CAS number 108-88-3, toluene.

Next, look again to the first column on page 310. Find the DOT ID and Guide Numbers 1294 130 at the bottom of this column, under Toluene. You can then find your copy of the DOT *Emergency Response Guidebook 2000* and turn to the orange section and find Guide Number 130, which is on pages 224-225. Here you can learn more about toluene. This DOT ID number would also be useful, for example, if a tanker truck at your work site started leaking. Not having a shipping manifest close by, you notice the numbers in the middle of the diamond-shaped placards on the truck. They read: 1294. Grabbing your handy *Pocket Guide*, you turn to the DOT ID Number Index at the back of the book and find 1294 in this column on page 380 (see column to the left on this page). You are sent to page 310 were you locate a chemical with the DOT ID of 1294. You discover that the DOT Guide Number for 1294 is 130 and the chemical is toluene.
The mustard-colored cover to the *ERG 2000* looks like this:

![ERG 2000 Cover](image)

On the top half of the next page are two pages for Guide Number 130 in the *ERG 2000*.

Moving to column two on page 310, one finds this heading: Synonyms, trade names, and conversion factors. Looking down to the third row at toluene, you determine that there are four other names for toluene, at least for now: Methyl benzene, Methyl benzol, Phenyl methane, Toluol. These names are useful when a label or the only information we can readily get is a synonym or trade name. Imagine a five gallon metal can with commercial label on it with the name Phenyl methane. What does this mean? To find out, look to the back of the *Pocket Guide* for the Synonym and Trade Name Index. On page 418 there are two columns. The second chemical from the bottom in the right-hand column is Phenyl methane, 310. That is right. On page 310 of the *Pocket Guide* there is a chemical with the synonym of phenyl methane – toluene. Finally, at the bottom of...
the column the conversion formula from vapors (ppm) to particulates (mg/m³) is given as 1 ppm = 3.77 mg/m³.

The third column from the left on page 310 is titled: Exposure limits (TWA unless noted otherwise). The Pocket Guide provides both the NIOSH REL (Recommended Exposure Limits) and the OSHA PEL (Permissible Exposure Limit) if available. Both limits are expressed in time-weighted averages (TWA). Short-term Exposure Limits (STEL) and Ceiling Limits (C) may also be given. Explanations for these terms are on pages ix-x of the “Introduction.” Looking at this column, the reader finds that OSHA-enforceable PEL for toluene is 200 ppm.

The fourth column is labeled IDLH. If a chemical has a concentration which has been determined to be Immediately Dangerous to Life or Health, the concentration is listed in this column. Toluene has an IDLH of 500 ppm. NIOSH defines an IDLH condition as one “... that poses a threat of exposure to airborne contaminants when the exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment.” More information on IDLH can be found on pages xi-xii of the “Introduction.”

The fifth column from the left on page 310 is Physical description. Toluene is described as being a colorless liquid with a sweet, pungent, benzene-like odor.
Chemical and physical properties is the next column and it is in turn divided into two columns. If the chemical has an RgasD value, it would be listed near the bottom of the column. Pages xii-xiii of the *Pocket Guide* list the abbreviations and what they represent. See the next page.

With two columns left on page 310, the only one to be discussed here is the Incompatibilities and reactivities column. Toluene is incompatible with strong oxidizers and will react.

The ninth column from the left or the first column on page 311 is Personal protection and sanitation (See Table 2). Table 2 is two pages starting with xviii. This column is straightforward and easy to understand.

The second column on page 311 keys directly to the Exposure and IDLH columns on page 310. Column Ten is Recommendations for respirator selection – maximum concentration for use (MUC), (See Table 3&4). See the box below.

| MW: 92.1 | VP : 21mm |
| BP: 232°F | FRZ: -139°F |
| Sol (74°F): | UEL: 7.1% |
| 0.07% | LEL: 1.1% |
| Fl.P: 40°F | |
| IP: 8.82 eV | |
| Sp. Gr. 0.87 | |
| Class IB Flammable Liquid | |

NIOSH
500 ppm: CCROV*(see page xv)/PAPROV*(see page xv)
/GMOV(see page xv)/SA*/SCBAF
§:SCBAF:PD,PP/SAF:PD, ASCBA.
Escape: GMFOV(see page xv)/SCBAE
Looking at Table 3 (beginning on page xx), one can find the numerous symbols and respirator abbreviations listed in Column Ten. For example:

**GMFOV** (APF=50) .... any air-purifying full facepiece respirator (gas mask) with a chin-style, front-or back-mounted organic vapor canister.

**SCBAE** .... Any appropriate escape-type, self-contained breathing apparatus.

**SCBAF: PD,PP** (APF=10,000) ... Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

**SAF:PD,PP:ASCBA** ... Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

The third column is First Aid (See Table 5). Recommended first aid for exposure to toluene is:

**Eye:** Irr immed  
**Skin:** Soap wash prompt  
**Breath:** Resp support  
**Swallow:** Medical attention immed
An example of a recommendation for first aid found on page xxxi is listed below.

**Breath:**

**Resp support ...................** If a person breathes large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform mouth-to-mouth resuscitation. Keep the affected person warm and at rest. Get medical attention as soon as possible.

The remaining column falls under the heading of Health hazards. These abbreviations are defined in Table 6. Table 6 begins on page xxxii and is three pages. Definitions for some of the abbreviations used above and others are provided. Page xxxiii is printed below:

<table>
<thead>
<tr>
<th>Code</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>fib</td>
<td>Fibrosis</td>
</tr>
<tr>
<td>ffg</td>
<td>Fatigue</td>
</tr>
<tr>
<td>func</td>
<td>Function</td>
</tr>
<tr>
<td>GI</td>
<td>Gastrointestinal</td>
</tr>
<tr>
<td>halu</td>
<td>Hallucinations</td>
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<tr>
<td>head</td>
<td>Headache</td>
</tr>
<tr>
<td>hema</td>
<td>Hematuria (blood in the urine)</td>
</tr>
<tr>
<td>hemato</td>
<td>Hematopoietic</td>
</tr>
<tr>
<td>hemorr</td>
<td>Hemorrhage</td>
</tr>
<tr>
<td>hyperpig</td>
<td>Hyperpigmentation</td>
</tr>
<tr>
<td>hypox</td>
<td>Hypoxemia (reduced oxygen in the blood)</td>
</tr>
<tr>
<td>inco</td>
<td>Incoordination</td>
</tr>
<tr>
<td>incr</td>
<td>Increased</td>
</tr>
<tr>
<td>inebri</td>
<td>Inebriation</td>
</tr>
<tr>
<td>inflamm</td>
<td>Inflammation</td>
</tr>
<tr>
<td>ing</td>
<td>Ingestion</td>
</tr>
<tr>
<td>inh</td>
<td>Inhalation</td>
</tr>
<tr>
<td>inj</td>
<td>Injury</td>
</tr>
<tr>
<td>insom</td>
<td>Insomnia</td>
</tr>
<tr>
<td>irreg</td>
<td>Irregular/irregularities</td>
</tr>
<tr>
<td>irrit</td>
<td>Irritation</td>
</tr>
<tr>
<td>irritity</td>
<td>Irritability</td>
</tr>
<tr>
<td>jaun</td>
<td>Jaundice</td>
</tr>
<tr>
<td>kera</td>
<td>Keratitis (inflammation of the cornea)</td>
</tr>
<tr>
<td>lac</td>
<td>Lacrimation (discharge of tears)</td>
</tr>
<tr>
<td>lar</td>
<td>Laryngeal</td>
</tr>
<tr>
<td>lass</td>
<td>Lassitude (weakness, exhaustion)</td>
</tr>
<tr>
<td>leucyt</td>
<td>Leukocytosis (Increased blood leukocytes)</td>
</tr>
<tr>
<td>leupen</td>
<td>Leukopenia (reduced blood leukocytes)</td>
</tr>
<tr>
<td>liq</td>
<td>Liquid</td>
</tr>
<tr>
<td>local</td>
<td>Localized</td>
</tr>
<tr>
<td>low-wgt</td>
<td>Weight loss</td>
</tr>
<tr>
<td>mal</td>
<td>Malaise (vague feeling of discomfort)</td>
</tr>
<tr>
<td>malnut</td>
<td>Malnutrition</td>
</tr>
<tr>
<td>methemo</td>
<td>Methemoglobinemia</td>
</tr>
<tr>
<td>muc memb</td>
<td>Mucous membrane</td>
</tr>
<tr>
<td>musc</td>
<td>Muscle</td>
</tr>
<tr>
<td>narco</td>
<td>Narcosis</td>
</tr>
<tr>
<td>nau</td>
<td>Nausea</td>
</tr>
<tr>
<td>nec</td>
<td>Necrosis</td>
</tr>
<tr>
<td>neph</td>
<td>Nephritis</td>
</tr>
<tr>
<td>numb</td>
<td>Numb/numbness</td>
</tr>
<tr>
<td>opac</td>
<td>Opacity</td>
</tr>
<tr>
<td>palp</td>
<td>Palpitations</td>
</tr>
<tr>
<td>para</td>
<td>Paralysis</td>
</tr>
<tr>
<td>pares</td>
<td>Paresthesia</td>
</tr>
<tr>
<td>perf</td>
<td>Perforation</td>
</tr>
</tbody>
</table>

The first health hazard listing is ER, for Exposure Route. Toluene may enter the body any of four ways: Inh; Abs; Ing; and Con.

The second Health hazards listing is (SY) for Symptoms. Symptoms listed for toluene are Irrit eyes, nose; lass, conf, euph, dizz, head; dilated pupils, lac; anxi, musc ftg. Insom; pares; derr; liver, kidney damage.

The final listing in column eleven is TO (Target Organs). A target organ is a part of the body that the chemical affects. The target organs for Toluene are: Eyes, skin, resp sys, CNS, liver, kidneys.
NOTES and SCRIBBLES

MSA Model 261 Battery-powered 2-gas Monitor
This chapter describes the personal protective and communications equipment you may need for safe confined space entry. The chapter contains a brief overview of the OSHA Respiratory Protection Standard, but it does not provide complete information on respirators. There is more background information on NIOSH respiratory protection factors at the back of the chapter.

When engineering controls, for example mechanical ventilation, can’t eliminate or control the atmospheric hazards in a permit space, entrants have to use respirators (d)(3)(iv). The type of respirator used depends upon the hazards in the space. Once monitoring shows that respiratory protection is required, respirator selection is made according to OSHA’s Respiratory Protection Standard (1910.134).

Fifty-six percent (56%) of confined space deaths are caused by atmospheric hazards: oxygen deficiency, oxygen enrichment, and flammable or toxic vapors and gases. When respirators are required to protect entrants, the type of respirator is determined by the atmospheric hazards in the space. The two main types of respirators are air purifying respirators and supplied air respirators.

**AIR PURIFYING RESPIRATORS (APRs)**

Air purifying respirators (APRs) filter out the contaminants from the air around you (ambient air). They do not supply you with clean breathing air.
**Question:**
When would you use an APR for confined space work?

**Only when ...**

- there’s **enough oxygen** (more than 19.5%) and **no chance of oxygen deficiency developing**
- you know the **identity** of the chemical and its **concentration**, and that the selected respirator offers **adequate protection**
- there is **continuous or periodic monitoring** of the space
- the contaminant is **not a cancer hazard**
- the contaminant has **adequate warning properties**

**SUPPLIED AIR RESPIRATORS (SARs)**

Supplied air respirators (SARs) give you the greatest respiratory protection because they supply you with clean breathing air. There are two types of SARs: self-contained breathing apparatus (SCBA) and airline respirators.

With SCBAs you can carry your air supply in a tank on your back. Airline respirators deliver the air to you through a hose connected to larger tanks or a special compressor. When you use an airline respirator in a confined space, you must also have an escape (egress) bottle. If anything happens to interrupt the flow of air coming to your facepiece (a fork lift running over the hose), you can switch over to the escape bottle and then exit the permit-space. Hip-placed escape bottles provide you with about five (5) minutes of breathing air (breathing at a normal rate). An escape bottle must be worn when using supplied air in a confined space.
Airline respirators are more comfortable than SCBAs because you don’t have the tank on your back. You can also get more work done without having to refill your air tank. If conditions allow you a choice, opt for the airline respirator with escape bottle.

**Question:**
When do you have to use a SAR?

**When ...**

- the oxygen content in the space is below 19.5%, or when there is a chance for oxygen deficiency
- the atmosphere contains unidentified contaminant(s)
- the concentration of the contaminant is **Immediately Dangerous to Life or Health (IDLH)**. IDLH conditions always require SARs
- the contaminant is a **carcinogen**
- the contaminant has **poor warning properties** (you can’t smell it or you can’t smell it until it reaches dangerous concentrations)
- APRs **cannot provide adequate protection** against the concentration of the contaminant found in the space. (See end of this chapter for background information on protection factors.)

**Asking for Trouble**

Confined spaces have limited or restricted means of entry and exit. Often the entry hole is too small for an entrant and his or her SCBA. Sometimes the entrant goes in wearing a mask and the tank is passed in after. Sometimes the tank is lowered in first. Either way fatalities occur when this happens. Airline respirators eliminate the problem of trying to get through a small opening with a tank on your back.

**THE OSHA RESPIRATORY PROTECTION STANDARD**
**29 CFR 1910.134**

The respiratory protection required for a permit-space entry must be listed on the entry permit. When respirators are required for permit-space entry, the employer must have a respirator program in accordance with OSHA’s Respiratory Protection Standard.
To comply with 1910.134 the employer must: (the following is not a complete list)

- **train** respirator-wearers in the proper use and limitations of respirators

- have **employees complete a medical questionnaire** and be cleared by a health care professional.

- have a **written respirator program**

- **select respirators** on the **basis of hazards** to which employees are exposed

- **monitor** work conditions and employee exposure

- make sure that respirators are **cleaned, disinfected, properly stored and inspected**

- make sure respirators “fit” properly

- **evaluate** the respirator program

**CHEMICAL PROTECTIVE CLOTHING AND OTHER PERSONAL PROTECTIVE EQUIPMENT (PPE)**

The PPE you wear in a confined space is determined by the hazards of the space. The PPE needed for entry must appear on the entry permit. PPE used for confined space entry can range from ordinary work clothes to a fully encapsulated chemical protective suit.

![PPE Diagram](image)

Coveralls  Hooded Coveralls  Splash Suit  Full Coverage  Fully Encapsulated  FE w/Outer Fire Suit

PPE can be hot and uncomfortable, and can make it hard to see, hear, and move. You need to balance the chemical hazards against the obstacles of wearing too much PPE.
Other types of PPE may include:

- **Gloves** — The type of glove you use depends on the hazards and the work to be done. They may be chemical-resistant, leather, cotton, and cut or abrasion resistant.

- **Approved eye protection** and/or **face shield**

- **Hard hat** and steel-toed or **chemical resistant work boots**

- **Hearing protection**

**COMMUNICATIONS EQUIPMENT**

29 CFR 1910.146 (h)(3) and (i)(5)

Entrants and attendants must be in contact with each other. According to the PRCS Standard, they must communicate “as necessary” so the attendant can make sure the entrant is okay. The attendant must be able to alert the entrant to leave the space immediately.

The shape of the permit space may prevent the attendant from being able to see the entrant. Noise may prevent them from being able to hear each other without special radio communication.

There are several communications systems on the market that have been NIOSH-approved for use with different respirators. Battery-operated, voice-activated systems leave the entrant’s hands free. Remember to check the battery before entering the permit-space. It is also important to check the transmission range of the units.

Alarms which are worn by the entrant and go off if the worker doesn’t move for a set period of time are also available. For example, the “motion detector” can be set to go off if the entrant doesn’t move for 20 seconds. Alarms must be loud enough to alert the attendant outside the space. These devices do not replace the need for good communications between entrant and attendant.

**BACKGROUND INFORMATION**

**NIOSH Respirator Protection Factors**

The **Protection Factor (PF)** is a measure of the protection your mask
gives you. It tells you if the respirator you’re using will protect you from the concentration of the chemical you are exposed to.

The assigned PFs for respirators are:

<table>
<thead>
<tr>
<th>Respirator</th>
<th>PF</th>
</tr>
</thead>
<tbody>
<tr>
<td>Half-mask APR</td>
<td>10</td>
</tr>
<tr>
<td>Full-facepiece APR</td>
<td>50</td>
</tr>
<tr>
<td>Full-facepiece PAPR (powered air purifying respirator)</td>
<td>50*</td>
</tr>
<tr>
<td>Airline respirator</td>
<td>2,000</td>
</tr>
<tr>
<td>SCBA</td>
<td>10,000</td>
</tr>
</tbody>
</table>

*Specific OSHA Toxic Chemical standards may be higher

Obviously, the higher the PF the better the protection.

The **Maximum Use Concentration (MUC)** is the highest concentration of a chemical a respirator can protect against. (Sometime the term Maximum Use Level will also be seen.)

To find the MUC, multiply the PF of the respirator by the PEL of the chemical you are exposed to.

\[
\text{PF} \times \text{PEL} = \text{MUC}
\]

If the concentration you are exposed to is above the MUC, then you need a better respirator!

**Here’s an example:**

You will be working in a space that has a concentration of 750 ppm of ethyl butyl ketone. Can you use a full facepiece APR? (The PEL for ethyl butyl ketone is 50 ppm.)

\[
\text{PF} \times \text{PEL} = \text{MUC}
\]

\[
___ \times 50 \text{ ppm} = _____ \text{ MUC}
\]

50 x 50 ppm = 2,500 ppm MUC

Yes, a full facepiece APR will protect you against a concentration of ethyl butyl ketone of up to 2,500 ppm.
Here’s another example:
You will be working in a space that has a concentration of 300 ppm of isopropylamine. Can you use a full facepiece APR? (The **PEL** for isopropylamine is **5 ppm**.)

\[
50 \times 5 \text{ ppm} = 250 \text{ ppm MUC}
\]

**No,** a full facepiece APR will only protect you against 250 ppm of isopropylamine. An APR will not protect you against 300 ppm of isopropylamine. **You will need to get a better respirator.**

One final example:
You will be working in a space with a concentration of dimethylaniline of **200** ppm. Can you use a full facepiece APR? (The **PEL** for dimethylaniline is **5 ppm**.)

\[
50 \times 5 \text{ ppm} = 250 \text{ ppm MUC}
\]

**No,** it looks okay, but it isn’t! The **IDLH** for dimethylaniline is only **100** ppm. **In IDLH conditions you must use a Supplied Air Respirator.**

If you use OSHA PFs to select the type of respirator you need, remember three important points:

- Always check the IDLH concentration of a chemical. The IDLH may be lower than the MUC (as in the example above).

- PFs are determined under ideal—not real—conditions. They are not foolproof and are probably too highly rated. If you have any doubts about your respirator being protective enough, go for a better respirator.

- If filters have an ESLI (End of Service-Life Indicator), check to see if it is time to change. Check your employer’s filter/cartridge change schedule to see if it is time to change filters.
SUMMARY

Only supplied air respirators — SCBAs and airline respirators with escape bottles — give you a clean, fresh supply of breathing air.

Air purifying respirators only filter out the contaminants from the air around you. (The air around you is also called ambient air.)

If you use an APR in a confined space you must know:

- that the oxygen content is between 19.5% and 23.5%
- the identity of the contaminant, its concentration and that your APR offers enough protection for that chemical at the concentration in the confined space
- the confined space is being monitored
- the chemical does not cause cancer or if it does, that it is legal to wear the APR
- the chemical has good warning properties
SMALL GROUP ACTIVITY

Personal Protective Equipment

An employee in Arizona entered a solvent storage tank to remove toluene residues. The tank was 15’ tall and 10’ in diameter. The employer had rented a self-contained breathing apparatus for this entry and showed the employees how to use it. The tank atmosphere had not been tested, nor had any provisions for rescue been made. The entrant could not fit through the tank’s opening while wearing the SCBA, so the employer decided that the SCBA would be lowered to him after he had reached the bottom of the tank.

The construction worker went into the tank and the supervisor lowered the SCBA. The worker collapsed before he could put it on. A call for help was sent to the city fire department. Because of the small opening, the firefighters who responded to the rescue call could not get into the tank with their SCBAs. The firefighters decided to cut open the side of the tank so they could rescue the victim.

To reduce the possibility of sparking, water was sprayed into the tank. When the firefighters cut into the tank, the toluene vapor in the tank ignited and the tank exploded. The explosion killed one firefighter and injured 16 others.

It was later determined that the entrant was dead before the explosion. It is also believed that applying water to the tank to reduce the sparking actually forced air into the tank. As a result, the tank’s toluene/air ratio changed and moved from a UEL atmosphere into an explosive one.

(This is a true story.)
Questions

1. What do you think caused the entrant’s death?

2. What steps should have been taken before anyone entered the tank?

3. What PPE (personal protective equipment) would you have wanted for this entry?

4. What other equipment should have been used during this confined space entry?

5. What else should have been done differently?
ACCIDENT SUMMARY

<table>
<thead>
<tr>
<th>Accident Type</th>
<th>Asphyxiating</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather</td>
<td>Warm, partly cloudy</td>
</tr>
<tr>
<td>Type of Operation</td>
<td>Sandblasting/painting contractor</td>
</tr>
<tr>
<td>Crew Size</td>
<td>Four</td>
</tr>
<tr>
<td>Collective Bargaining</td>
<td>No</td>
</tr>
<tr>
<td>Competent Safety Monitor on Site?</td>
<td>Yes</td>
</tr>
<tr>
<td>Safety and Health Program in Effect?</td>
<td>Limited</td>
</tr>
<tr>
<td>Was the Worksite Inspected Regularly?</td>
<td>Yes</td>
</tr>
<tr>
<td>Training and Education Provided?</td>
<td>Inadequate</td>
</tr>
<tr>
<td>Employee Job Title</td>
<td>Sandblaster/Painter</td>
</tr>
<tr>
<td>Age/Sex</td>
<td>56/M</td>
</tr>
<tr>
<td>Experience at this Type of Work</td>
<td>5 years on a permanently assigned crew</td>
</tr>
<tr>
<td>Time on Project</td>
<td>45 minutes</td>
</tr>
</tbody>
</table>

BRIEF DESCRIPTION OF ACCIDENT

A contract employee was assigned to sandblast the inside of a reactor vessel during turnaround activities at a petrochemical refinery. Instead of relying on the contract company’s own air compressors in accordance with the contractor’s policy, the contract foreman connected the employee’s supplied air respirator to a hose containing what he thought was plant air. Instead it was nitrogen. Both hoses were identical except for markings at the shutoff valve. The sandblaster entered the vessel, descended to the bottom, placed the respirator hood on his head and was overcome.

ACCIDENT PREVENTION RECOMMENDATIONS

1. Employers must instruct employees to recognize and avoid unsafe conditions associated with their work (29 CFR 1926.21(b)(2)).

2. Contractors should follow a policy of using only their own air compressors or breathing air cylinders for their employees.

3. Middle and/or upper management personnel should routinely check first line supervisors to insure they are following established company safety policies.

SOURCES OF HELP

Safety and Health Requirements for Working in Confined Space, a slide-tape training program including instructor’s guide and class handouts, helps employees recognize potential sources of danger in confined spaces and explains how to select and use proper protective clothing and equipment. Available from the
NOTES, SCRIBBLES & PICTURES

HEPA Filtered Continuous Flow Respirator

Intrinsically Safe Flashlight

Spectacle Adapter for Full-face Respirator
This chapter explains the procedures for isolating permit-spaces from sources of energy and materials. Confined spaces must be isolated as provided by 29 CFR 1910.147, “The Control of Hazardous Energy (lockout/tagout)” and other federal and state OSHA standards.

For confined space work, lockout procedures prevent switches from being accidentally activated or valves from being turned on. Tag/out procedures warn employees that machinery, equipment, pipe transfer systems, and such have been de-energized or blocked so work can be safely performed.

**ISOLATING THE PERMIT SPACE**

29 CFR 1910.146 (d)(3)(iii)

Before the air inside a permit-space is monitored, the space must be taken out of service and disconnected from all energy sources. The permit-space must be isolated from all substances that could enter the space and contaminate the air or engulf an entrant.

**Locking Out Electricity**

Machinery and wires inside confined spaces present serious hazards for entrants. To isolate the permit-space from electricity, open (turn off) the disconnect or circuit breaker (pull fuses at the disconnect), and then place your lock on the device, effectively isolating power at the source. Turning off a switch is not enough; you must turn the power off at the box. Once the power is shut off and locked out, try switching on the power to make sure you locked out the right source (verification). Each lock on the box should have only one key.

You should be the only person who can remove your lock. If each entrant puts a lock on the electrical box, the power can’t be switched on until the last entrant is out of the permit-space. Sometimes, however, there might be a lock box for large crews or a master key or multi-key system as provided on the top of the next page.
Lockout scissors are useful devices when more than one lock has to go on an energy source.

Isolation also includes disconnecting mechanical connections such as chains that run drive shafts and using blocks to stop moving parts (for example, fan blades).

**Pipes, Lines, Ducts and Valves**

Pipes, lines, and ducts that carry liquids or gas must be disconnected from the confined space. This is especially important if flammable, corrosive, or toxic chemicals are carried in the lines. Any liquid which is under pressure or at a high volume could engulf an entrant. Inert gases such as nitrogen which are used to purge confined spaces of air contaminants can asphyxiate entrants if lines are left open. Heated liquids, even at low pressure or volume, could still cause serious harm.

Line breaking, blanking or blinding, double blocking and bleeding, and removing sections of pipes are some of the methods used to isolate permit spaces. It is not enough to turn off and lock a valve. The pipe needs to be blocked so that nothing can get through.
How lines/pipes/ducts are handled for permit spaces depends upon the configuration of the space and line, the work to be done, and what’s in the pipes/lines/ducts. The procedures to be used must be part of the contractor’s confined space program.

**Blanking or blinding**

The blank or blind is the block that you put into the line or pipe at a joint. The pipe line is first bled to relieve and pressure. Flange bolts are removed to separate the pipes. The blank or slip blind, which is sometimes referred to as a pancake, is inserted between the two pipes and bolted. Blanks need to fit tightly with all bolts in place. They must be strong enough to withstand four times the pressure in the line. You want to be sure that even if the valve is opened, nothing will get through. Inserting blanks into chemical lines can be hazardous. It is important to know if the chemical in the line reacts with any metals. For example, carbon tetrachloride may react with a blank made of aluminum.

Once a line is blanked, turn off and lock-out the valve. When the valve is locked-out, make sure it doesn’t move more than a one-quarter turn (verification).

Blanking/blinding can also be used to separate a pipe and then seal both ends.

**Double block and bleed**

Two in-line valves are closed and locked. A vent valve (drain) in-between the two closed valves is then opened and locked.
Some contractors may remove a section of a pipe/duct and place a lock through a bolt hole to prevent accidental resectioning. This practice is called “spooling the line”.

Valves, whether opened or closed, should be locked out. Each entrant should have a lock on the valve. If the only lock on a valve belongs to the person who isolated the line, it is possible that the line could be opened before the confined space is vacated. If each entrant has a lock on the line, this can’t happen.

Valve-wheel covers for short-stemmed valves

In-line valve enclosure
A LOCKOUT/TAGOUT PLAN
29 CFR 1910.147 (c)(4)

Annually about 144 workers die from workplace incidents involving the accidental release of hazardous energy on the job. OSHA believes that effective lockout/tagout plans based on its 29 CFR 1926.147 can annually prevent 85% or 122 fatalities.

A basic LO/TO Plan (Lockout/Tagout Plan) will have several steps for the effective implementation of lockout/tagout procedures. In addition to supervision, a plan will outline the duties of both the affected employee and the authorized employee. According to 29 CFR 1910.146 (b), the...

**Affected employee.** An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

**Authorized employee.** A person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment.

An affected employee becomes an authorized employee when that employee’s duties include performing servicing or maintenance....

**Typical LO/TO Plan**

A basic permit required confined space lockout/tagout plan will list the procedures needed to prevent injury or death to confined space entrants and rescuers where, in a worse case event, switches may accidentally be activated or valves turned on.

A basic LO/TO plan may contain a least the following steps:

- Planning
- Notification of All Employees
- Shutdown Machinery at Operating/Operator Controls
- Isolation of All Energy Sources
- Lock and Tag All Isolating Devices
- Eliminate All Stored or Residual Energy
- Verification of Isolation

SMALL GROUP ACTIVITY

1. Why is a lockout/tagout program needed for confined spaces?

2. As confined space entrant, what would you do if you find a lockout tag unattached, torn, or defaced?

3. What is an:
   
   Affected employee –

   Authorized employee –
4. What is the **one worker, one lock** rule and why is it needed?

5. Can an affected employee assist an authorized employee with lockout/tagout procedures?

6. Suppose an entrant is going to work on a permit-space that had one electrical box, a steam pipe, and three chemical lines – all which had to be locked and tagged out. How many locks and tags should he or she have?
SUMMARY

- Your contractor must have a written lockout/tagout plan that provides for safe procedures for affected and authorized employees.

- For a confined space, the space must be taken out of service and disconnected from all energy sources.

- For a confined space, the space must be isolated from all substances that could enter the space and contaminate the air, engulf the entrants, or make the space flammable/explosive.

- **Affected employee** and **authorized employee** have specific roles and responsibilities listed in a lockout/tagout plan.

- The **one lock - one key** rule should always be in effect.
**ACCIDENT SUMMARY**

<table>
<thead>
<tr>
<th>Accident Type</th>
<th>Electrocution</th>
</tr>
</thead>
<tbody>
<tr>
<td>Weather</td>
<td>Raining</td>
</tr>
<tr>
<td>Type of Operation</td>
<td>Electrical Contractor</td>
</tr>
<tr>
<td>Crew Size</td>
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</tr>
<tr>
<td>Collective Bargaining</td>
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</tr>
<tr>
<td>Competent Safety Monitor on Site?</td>
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</tr>
<tr>
<td>Safety and Health Program in Effect?</td>
<td>Inadequate</td>
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<tr>
<td>Was the Worksite Inspected Regularly?</td>
<td>Yes</td>
</tr>
<tr>
<td>Training and Education Provided?</td>
<td>No</td>
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<td>Employee Job Title</td>
<td>Journeyman Electrician</td>
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<td>Age/Sex</td>
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<td>Experience at this Type of Work</td>
<td>16 years</td>
</tr>
<tr>
<td>Time on Project</td>
<td>1 day</td>
</tr>
</tbody>
</table>

**BRIEF DESCRIPTION OF ACCIDENT**

An electrician was removing metal fish tape from a hole at the base of a metal light pole. The fish tape became energized, electrocuting him.

**INSPECTION RESULTS**

As a result of its inspection, OSHA issued a citation for three serious violations of the agency's construction standards. Had requirements for de-energizing energy sources been followed, the electrocution might have been prevented.

**ACCIDENT PREVENTION RECOMMENDATIONS**

1. Ensure all circuits are de-energized before beginning work (29 CFR 1926.416(a)(3)).
2. Controls to be deactivated during the course of work on energized or de-energized equipment or circuits must be tagged (29 CFR 1926.417(a)).
3. Employees must be instructed to recognize and avoid unsafe conditions associated with their work (29 CFR 1926.21(b)(2)).

**SOURCES OF HELP**

- Construction Safety and Health Standards (OSHA 2207) which contains all OSHA job safety and health rules and regulations (1926 and 1910) covering construction.
- OSHA-funded free consultation services. Consult your telephone directory for the number of your local OSHA area or regional office for further assistance and advice (listed under U.S. Labor Department or under the state government section where states administer their own OSHA programs).
- OSHA Safety and Health Training Guidelines for Construction (available from the National Technical Information Service - Order No. PB-239-312/AS) comprised of a set of 15 guidelines to help construction employees establish a training program in the safe use of equipment, tools, and machinery on the job.

**NOTE:** The case here described was selected as being representative of fatalities caused by improper work practices. No special emphasis or priority is implied nor is the case necessarily a recent occurrence. The legal aspects of the incident have been resolved, and the case is now closed.
This chapter explains why and how to ventilate a confined space. There is information on the type of equipment to use and how to use that equipment safely and effectively. \((d)(3)(iv)\)

Poor natural ventilation is a common feature of confined spaces. A hazardous atmosphere can be oxygen deficient or oxygen enriched; it can contain flammable, or toxic gases and vapors. Engineering controls such as mechanical ventilation are the most effective way to eliminate or control atmospheric hazards.

The ventilation methods used in a confined space will be determined by:

- shape and function of the space
- chemical residues remaining in the space
- natural air movements
- blocks to air flow
- the number and location of entry/exit openings
- what the work is, and where it will be done
- the types of hazards that occur with each task

The goal of ventilation is to keep fresh air moving through the space, making the air safe to breathe and work in.

Mechanical ventilation must be applied carefully. Blowing air into a space that contains flammable chemicals could increase the possibility of explosion. Before ventilating, many permit spaces will need to be purged to eliminate flammable or toxic vapors/gases.

**MECHANICAL VENTILATION**

It is better to move air mechanically through a confined space than to rely upon natural air flow. Portable fans and blowers ensure a reliable air flow,
and can be moved as work conditions change. When air is moved through a confined space, the amount of air taken out needs to be put back in. It’s important to draw ‘make up’ air into the space when a fan is pulling air out. Likewise, it’s important to have a place for air to go when a fan is pushing it in.

Always ventilate confined spaces with clean breathing air. **Never ventilate with pure oxygen.** Oxygen can increase the risk of fire and explosion.

There are two types of mechanical ventilation used in confined spaces: local exhaust and dilution ventilation.

**Local exhaust ventilation** captures air hazards where they are generated. An inlet hood is set close to the work. Contaminants such as welding fumes or toxic vapors are drawn away from the worker, preventing those contaminants from reaching the worker and mixing with the air in the confined space.

The local exhaust system has four parts:

1. Hoods for capturing the air contaminants
2. Rigid or flexible hose/duct work for carrying the contaminants out of the space
3. Air cleaning devices that remove contaminants from the air stream
4. Fans that provide the energy needed to move the air through the system

**Dilution ventilation** uses fans to push or pull fresh air through the space to “dilute” the concentration of gases and vapors in the air. To deliver and direct the air into a confined space, hoses are attached to fans. An amount of fresh air equal to the volume of the confined space is called an air exchange. Because the fresh air is mixed with the contaminated air, several air exchanges are required to dilute the air in the confined space enough to test for entry. NIOSH recommends 20 (1985) air exchanges in a permitted confined space before testing for entry.
To figure out how long it will take to ventilate a confined space, you need to know the rated air flow and the effective air flow. The rated air flow is determined by the manufacturer and is usually indicated on the equipment. The air flow coming out of the hose is called the effective air flow or effective blower capacity. The effective air flow will always be less than the rated flow, and is determined by the size, length, bends and other characteristics of the hose.

**AIR EXCHANGE FORMULA**

To find the amount of time one air exchange will take, use this formula:

\[
\frac{\text{Volume of space} = L \times W \times H}{\text{Effective Air Flow in cfm}} = \text{Time for one air exchange}
\]

\[
\frac{1600 \text{ cubic Feet}}{400 \text{ cfm}} = 4 \text{ minutes for 1 air exchange}
\]

To find out how long it would take your crew to complete the NIOSH recommended 20 air exchanges, multiply the four (4) minutes by twenty (20). In this example, it would take 1 hour and 20 minutes to complete the twenty air exchanges.

Where and how the ventilation equipment is positioned affects the air flow in a confined space. The location of the fan in relation to the entry/exit openings is important in providing good air flow. If the entry/exit and the fan are on the same side of the space, the air may mix well in one area but poorly in another.
Ventilation should be placed to take advantage of the natural tendency of contaminants to rise or sink. Contaminants that are heavier than air should be drawn off from near the bottom of the space. Lighter than air contaminants should be drawn off from the top.

Hot work, such as welding, may need local exhaust to capture fumes and particles. Dilution and exhaust fans can be set up to work together, in this case by pushing and pulling air. Blow air in from behind and past the worker to dilute gases and particles in the air. Use local exhaust where the work is happening to keep the worker from breathing the fume or dust. A supplied air respirator may be necessary during hot work if local exhaust cannot be supplied.
Selection of Ventilator

There are three types of ventilators used in confined spaces:

- **Self-contained ventilators**: Self-contained ventilators are small, portable units that run on either LP-gas or gasoline. Depending on their size, these units can deliver between 600-1400 cubic feet of air per minute (cfm).

- **Motor driven units**: Motor driven units run on electricity. Motor driven ventilators should be certified intrinsically safe to prevent the possibility of a fire or explosion. Large units can deliver up to 20,000 cfm.

- **Compressed air driven units**: Compressed air units use compressed air to move larger amounts of air or drive fan blades. These units may be either portable or fixed in place.

Look for the following features in a fan or blower:

- portability
- high flow rate
- intrinsic safety
- ground fault circuit interrupters (GFCI)
- power loss alarm; and
- hose attachments of different lengths to move air to where it is needed

An important difference between air supply systems and air exhaust systems is that fans can exhaust or “blow” air much farther than they can capture or pull it in. In general, the ratio of exhausting to capture is 30:1. This means that a fan that is capable of blowing air a distance of thirty (30) feet will only be able to capture (pull) in contaminants that were within a one (1) foot distance.
Entry and exit from confined spaces can be difficult when ventilation hoses get in the way. The Saddle Vent™ allows for easy entry and exit without interrupting the air flow.

Fans and blowers are noisy. Working near them can interfere with communication and affect hearing if no protection is used. Two-way communication equipment for attendants and entrants should be used when noise makes communication difficult.

**PURGING AND VENTILATING CONFINED SPACES**

If the concentration of an explosive gas/vapor in a confined space is above the Upper Explosive Limit (UEL), don't add fresh air to the space. Adding air can push the fuel/air mixture below the UEL right into the explosive range!

Purging the space with a non-explosive gas like nitrogen or carbon dioxide will replace the atmosphere in the space. Nitrogen and carbon dioxide are inert gases because they don’t react easily with other substances. Purging a space with inert gas is called inerting.

A confined space should be purged until the concentration of explosive gases/vapors is safe. The space must then be ventilated with clean breathing air to make sure there is enough oxygen in the confined space.
SUMMARY

- Never ventilate confined spaces with pure oxygen.
- Always ventilate confined spaces with clean breathing air.
- Position fans and hoses to get the best air flow by moving air across the space if possible.
- If the level of flammable gases or vapors in a confined space is above the UEL (upper explosive limit), first purge the space with an inert gas such as nitrogen. When the flammable gases are less than 10% of the LEL, ventilate the space with clean breathing air.

Gases and vapor that are heavier than air should be drawn off from the bottom while providing make up air from the top.

Lighter than air gases should be drawn off from the top and make up air provided from the bottom.
SMALL GROUP ACTIVITY

Preparing for Confined Space Entry

A reactor vessel, 30’ tall and 15’ in diameter, is shut down for screen replacement and general maintenance. The tank has been drained, lines blanked, and valves locked out. Nitrogen, pumped in from the bottom of the tank, is used to purge the system before the two entrants begin work. After the nitrogen purge, the base of the tank is monitored for oxygen and explosive vapors.

The two entrants are to work off a platform and remove the screen which sits about 30” below the top of the vessel. As the construction workers positioned themselves opposite each other to remove the old screen, one of them dropped his glasses. The glasses landed on the screen. He lowered his head and shoulders into the vessel and reached down to get his glasses. The man died in the time it took him to reach for his glasses.

The entrants were not wearing any PPE. Neither of the workers had been trained in confined space entry.

In your groups answer the following questions:

1. What do you think caused this man’s death?

2. What steps could have prevented the death?

3. List the good practices mentioned in this scenario.

(This is a true story.)
This chapter examines the duties of entrants, attendants, and entry supervisors and the training they each require under the OSHA PRCS Standard. The safety of confined space entry work depends on well-trained workers and a good confined space entry program.

**Paragraph (g) of the OSHA 1910.146 Standard** says that employers must train employees who will do confined space work.

This training must be given:

- before the worker is given a confined space job to do - (g)(2)(i)
- before duties are changed - (g)(2)(ii)
- when a new permit space hazard appears that employees have not been trained about - (g)(2)(iii)
- when the employer thinks the permit system isn’t being followed properly - (g)(2)(iv)

The training must ensure that workers are able (proficient) to do all the duties required of them - (g)(3). Any new or revised procedures must also be covered in the training. Employers must certify in writing that the training was conducted - (g)(4).

**CONFINED SPACE ENTRANTS**

**Paragraph (h)**

Entrants are the workers who enter the permit space. The training they receive must cover the following topics:
1. **The hazards that can exist in a confined space.** Entrants must know the signs and symptoms of exposure to the hazards in the space - (h)(1).

2. **Equipment.** Entrants need to know how to use - (h)(2):
   - monitoring equipment that is used in the permit space
   - ventilating equipment for making the atmosphere safe
   - communications equipment for maintaining contact with the attendant
   - PPE that one has to wear
   - lighting equipment
   - barriers to keep people and things Out of the space
   - equipment, such as ladders, to use for safe entry and exit
   - rescue and emergency equipment unless this equipment is provided by outside rescue services
   - any other equipment which must be used for safe entry

3. **Communication - (h)(3) and (h)(4).** Communication is vital to the safety of entrants. Entrants and attendants must communicate with each other while the entrant is in the permit space. The attendant needs to know that the entrant is okay. The entrant needs to be able to alert the attendant when he or she sees a dangerous situation or recognizes signs or symptoms of hazard exposure.

4. **Evacuation - (h)(5).** Entrants need to be able to exit the permit space quickly and safely under hazardous situations. Entrants must leave the permit space when:
told to exit by the attendant or entry supervisor
• the entrant notices signs or symptoms of exposure or a prohibited (dangerous) situation arises
• an evacuation alarm is sounded

CONFINED SPACE ATTENDANTS

Paragraph (i)

Attendants do not enter the permit space. They stay outside the permit space and in communication with the entrant. As long as there is an entrant inside a permit space, the attendant cannot leave his or her post until relieved by another trained attendant.

Attendants must not do any other work that could interfere with their attendant duties (i)(10). In emergencies, attendants can try to rescue entrants from outside the space. Unless the attendant is a trained rescuer, the attendant must remain outside the confined space (i)(9). Attendants who are trained rescuers can enter the permit space in an emergency, but only when they are relieved by another trained attendant (i)(4).

Responsibilities of Attendants:

• know potential hazards of permit space entry - (i)(1)
• know the signs, symptoms and effects of exposure; especially any changes in behavior of the entrants that could be caused by exposure to hazards - (i)(2)
• keep continuous count of entrants and their identity - (i)(3)
• monitor activities inside and outside the space and order entrants to evacuate if - (i)(5) and (i)(6):
° attendant detects a prohibited condition
° attendant thinks entrant’s behavior could be due to exposure
° attendant notices a dangerous situation outside the space that could harm entrants
° attendant can’t perform all duties properly
° call rescue and emergency team immediately if entrants need help - (i)(7)
° keep unauthorized people away from permit space - (i)(8)

The PRCS Standard allows attendants to monitor more than one permit space at a time provided they can still do all their duties effectively. (See “note” to (d)(6).

CONFINED SPACE SUPERVISORS

Paragraph (j)

The entry supervisor (ES) is the person who is responsible for deciding if the permit space is ready for safe entry. The ES authorizes the entry, oversees operations and ends the operation as required. The ES may also act as an entrant or attendant as long as he or she has received the proper training.

Entry supervisors must:

° know potential hazards of the permit space as well as signs, symptoms and effects of exposure - (j)(1)
° check that the entry permit is complete and accurate and that (j)(2):
  ° all required air monitoring has been done
  ° all required procedures and equipment listed on the permit are in place
° end the entry and cancel the permit if (j)(3) and (e)(5):
° the job is done

° a prohibited condition arises in or near the permit space

- check that rescue services are available, and that the means for contacting the rescuers works - (j)(4)

- keep unauthorized people out of the permit space - (j)(5)

- make sure safe entry conditions are maintained. The ES must check conditions periodically depending on the hazards of each entry. Conditions must be tested when an ES hands over his or her duties to another ES (j)(6).

**SUMMARY**

- Employers must train employees who do confined space work and retain records of their training.

- Entrants need to understand the hazards of confined spaces, how to use equipment and PPE, be able to communicate with other entrants and the attendant(s), and know how to exit confined space both under normal circumstances and under hazardous situations.

- Attendants remain outside the confined space to support the entrant(s). They must understand the hazards of the confined space, keep track of the entrants, keep unauthorized people away from the permit space, determine if and when a situation calls for the retrieval or rescue of an entrant, and initiate retrieval and/or rescue efforts if the situations calls for it.

- Supervisors must understand the hazards of the confined space, make sure the entry permit is complete and accurate, make sure safe conditions are maintained, keep unauthorized people away from the permit-space, end the job sand cancel the permit at the end of the job or if a prohibited condition arises, and initiate retrieval and/or rescue efforts if the situations calls for it.
Can you guess who is “Russ the CS Supervisor” in each of these pictures?
CHAPTER EIGHT
OSHA Permit System and the Entry Permit

This chapter uses the OSHA permit system as a guide to safe confined space entry. The goal of this session is to set out uniform safe procedures which should be followed for all confined space, not just permit space, entries.

OSHA establishes minimum safety and health standards. Many companies have confined space entry programs which are more protective of health and safety than OSHA’s program. These employers require entry permits for all confined spaces, not just permit spaces. Unions and employers can work together to write guidelines for confined space entry that will better protect you and your union brothers and sisters.

OSHA’s DEFINITION OF CONFINED SPACE

The OSHA Permit-Required Confined Space Standard (29 CFR 1910.146) establishes a two-tier definition of confined spaces:

- confined spaces and
- permit-required confined spaces (PRCS or permit space)

According to OSHA, only permit-required confined spaces require entry permits. CPWR recommends that all confined space entries use the permit system.

OSHA says that a confined space (one that doesn’t need a permit):

- is big enough and shaped so that someone can enter the space and do the work
- has limited or restricted means of entry/exit, and
- is not designed for continuous occupancy

A permit-space is a confined space that also has one or more of the following properties:
- a hazardous atmosphere or the potential for a hazardous atmosphere
- contains material that could engulf an entrant (grain, water, etc.)
- a shape that could trap or suffocate an entrant (i.e.: sloping floor or converging walls)
- contains any other recognized serious safety or health hazard

The Permit System

The permit system is explained in paragraph (e) and (f) of the OSHA Confined Space Standard. Paragraph (e) explains how entry permits are prepared, signed, canceled, terminated, and stored. Paragraph (f) lists the information which is required on all entry permits.

Paragraph (e):

1. **Before entry starts,** your employer must prepare an entry permit which at a minimum documents:

   - the conditions which are considered safe for entry
   - that the space has been isolated by locking-out energy sources; blanking pipes, etc.
   - that atmospheric hazards have been eliminated or controlled (by ventilating, purging and/or inerting)
   - that barriers are in place that will keep objects from falling into the space
   - that safe entry conditions will be maintained throughout the entry work

2. Entry into the space is authorized when the supervisor listed on the permit **signs the permit.**

3. The completed permit has to **be posted** so that all the entrants can read it.

4. The permit is **valid only for as long as the job takes.**

5. The supervisor has to **stop entry and cancel the permit** when:
- the work listed on the permit is finished, or

- an unsafe condition in or near the confined space starts.

6. Any problems that occur during a confined space entry must be noted on the permit.

7. Your employer has to keep canceled permits for at least one year. These permits are supposed to be used in your employer’s annual review of the confined space program.

Paragraph (f)

There isn't any standard entry permit form. All permits must contain all the information listed in paragraph (f) of the OSHA Confined Space Standard.

The following information must appear on all confined space entry permits:

1. The space that is going to be entered.

2. Why the space needs to be entered (description of the work to be done).

3. The date and the length of time the permit is good for.

4. Name(s) or some other identification of the authorized entrants.

5. Name(s) of the attendant(s).

6. Name of the entry supervisor. A space for the signature or initials of the entry supervisor who originally authorized entry.

7. The hazards of the space.

8. How the space will be isolated (for example, purged, ventilated, inerted, blanked and blinded, locked-out), and how hazards will be eliminated or controlled.

9. The conditions that must exist for entry to begin.

10. Air monitoring results and the name(s) or initials of the people who did the monitoring. The permit must also show when the tests were done.
11. **Who to call for emergencies and rescue** and how to contact them.

12. How entrants and attendants will **communicate** with each other.

13. **All the equipment** which has to be provided to **comply with the Standard**. This includes monitoring equipment, personal protective equipment, communication and rescue equipment, and alarms.

14. **Any other information** which is needed to ensure worker safety during confined space entry.

15. **Other permits**, such as hot work permits, which are needed for the work to be done.

The permit on the next page is a generic example of an entry permit. The one you see at work may look different but it must contain the same information.
**CONFINED SPACE ENTRY PERMIT**

<table>
<thead>
<tr>
<th>COMPANY/LOCATION</th>
<th>DEPARTMENT:</th>
<th>DATE:</th>
</tr>
</thead>
<tbody>
<tr>
<td>CONFINED SPACE TO BE ENTERED:</td>
<td>PERMIT EXPIRATION DATE/TIME:</td>
<td></td>
</tr>
<tr>
<td>DESCRIPTION OF WORK TO BE PERFORMED:</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**NATURE OF HAZARDS IN CONFINED SPACE:** (check)
- Oxygen deficiency (Less than 19.5% at sea level)
- Flammable gases or vapors (greater than 10% of the lower flammable limit, or greater than 23.5% oxygen at sea level)
- Toxic gases or vapors (greater than the permissible exposure limit)
- Mechanical hazards
- Electrical shock
- Materials harmful to the skin
- Engulfment
- Configuration hazard
- Other

**EQUIPMENT REQUIRED FOR ENTRY AND WORK:** (check)
- Respirator
- Lighting (Explosive Proof)
- Lifeline and safety harness
- Fire Extinguishers
- Protective clothing
- Emergency Escape Retrieval Equipment
- Hearing protection
- Resuscitators — Inhalator
- Other

<table>
<thead>
<tr>
<th>Electrical equipment/tools:</th>
</tr>
</thead>
<tbody>
<tr>
<td>Low voltage</td>
</tr>
<tr>
<td>Ground-fault current interrupters</td>
</tr>
<tr>
<td>Approved for hazardous locations</td>
</tr>
</tbody>
</table>

**Respiratory protection (specify)**

**Communication aid (specify)**

**Rescue equipment (specify)**

**PREPARATION:** (check)
- Notify affected departments or service interruption
- Isolate - blanked or double valve, with lock and tag.
- Zero energy state (Lock Out all energy sources)
- Cleaned, drained, washed and purged
- Ventilation to provide fresh air
- Emergency response team available
- Employees informed of specific confined space hazards
- Secure area (post, sign and flag)
- Procedures reviewed with each employee.
- Atmospheric test in compliance.
- Attach hot work permit
- Other

**AUTHORIZED ENTRANTS:**

**AUTHORIZED ATTENDANTS:**

**STAND BY SAFETY PERSONNEL:**

**TEST**

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<tbody>
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<td>Flammability</td>
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</table>

Name of employee conducting atmospheric monitoring: ____________________________

Instrument(s) used: ________________________________________________________

Statement of acceptable entry conditions: ___________________________________

**AUTHORIZATION:**

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

Name (Print): ____________________________

Time: ____________________________
Date: ____________________________
Signature: ____________________________

8-5
SMALL GROUP ACTIVITY — Scenario One

Preparing a Confined Space Entry Permit: The Barge

As a group, fill out the Confined Space Entry Permit for the work described below. You (the group) are the entry supervisor on the barge where the work is being done. You have to decide how many entrants are needed, the personal protective equipment needed and the communications and rescue/ retrieval equipment that should be used.

Welding in a Barge Hold

A pump needs to be installed in a diesel fuel tank on your barge. A 2-foot square hole needs to be cut through the holding tank wall. Entrants will be working in a small room next to the tank. That space is entered through a small door mounted on the top deck. Entrants will need to do some welding. The floor where the entrant will work is covered with a greasy sludge, seaweed and sea water. The air in the space smells like something is rotting. Portable electric lighting is needed to illuminate your work area.

Air monitoring results in the barge hold show:

- oxygen = 19.7 %
- percent of the LEL = 1%
- hydrogen sulfide = 6 ppm
- diesel oil vapors = 5ppm

Air monitoring results inside the diesel fuel tank are:

- oxygen = 19.9%
- percent of the LEL = 20%
- hydrogen sulfide = 1 ppm
- diesel oil vapors = 200 ppm

Use your NIOSH Pocket Guide and the diesel oil MSDS which begins on the next page to research the chemicals mentioned.
CHEVRON ENVIRONMENTAL HEALTH CENTER --
CHEVRON DIESEL FUEL NO. 2 -
DIESEL FUEL NO. 2 MATERIAL SAFETY DATA SHEET

NSN: 9140002865297
Manufacturer's CAGE: 0AH1
Part No. Indicator: A
Part Number/Trade Name: CHEVRON DIESEL FUEL NO. 2

General Information

Item Name: DIESEL FUEL NO. 2
Company’s Name: CHEVRON ENVIRONMENTAL HEALTH CENTER INC.
Company's Street: 15299 SAN PABLO AVE.
Company's P. O. Box: 4054
Company's City: RICHMOND
Company's State: CA
Company's Country: US
Company's Zip Code: 94804-0054
Company's Emerg Ph #: 415-233-3737
Company's Info Ph #: 415-233-3737
Distributor/Vendor # 1: CONWAY OIL CO (505-461-1960)
Distributor/Vendor # 1 Cage: 0HJZ1
Distributor/Vendor # 2: PETROLEUM TRADERS CORP (219-432-6622)
Distributor/Vendor # 2 Cage: 7W738
Distributor/Vendor # 3: HONSTEIN OIL CO (505-471-1800)
Distributor/Vendor # 3 Cage: 0CXZ1
Distributor/Vendor # 4: REDWOOD OIL CO, AFFIL OF GIBSON OIL CO
Distributor/Vendor # 4 Cage: 0G5C3
Record No. For Safety Entry: 003
Tot Safety Entries This Stk#: 089
Status: SE

Date MSDS Prepared: 03JAN92
Safety Data Review Date: 24OCT92

Supply Item Manager: KY
MSDS Serial Number: BKPHP
Specification Number: VVF800GRADEDF2RE
Spec Type, Grade, Class: DF-2 GRADE
Hazard Characteristic Code: F8
Unit Of Issue: DR
Unit Of Issue Container Qty: 55 GALLONS
Type Of Container: 18 GAUGE
Net Unit Weight: 366.4 LBS
Ingredients/Identity Information

Proprietary: NO
Ingredient: PETROLEUM MID-DISTILLATE (DIESEL MARINE FUEL)
Ingredient Sequence Number: 01
Percent: UNKNOWN
NIOSH (RTECS) Number: 1004302PE
CAS Number: 68476-34-6
OSHA PEL: 5 MG/M3 AS OIL MIST
ACGIH TLV: 5 MG/M3 AS OIL MIST
Other Recommended Limit: NONE SPECIFIED

Proprietary: NO
Ingredient: DISTILLATES, STRAIGHT RUN MIDDLE
Ingredient Sequence Number: 02
Percent: UNKNOWN
NIOSH (RTECS) Number: LX3296000
CAS Number: 64741-44-2
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE SPECIFIED

Proprietary: NO
Ingredient: HYDRODESULFURIZED MIDDLE DISTILLATE
Ingredient Sequence Number: 03
Percent: UNKNOWN
NIOSH (RTECS) Number: LX3296000
CAS Number: 64742-80-9
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE SPECIFIED

Proprietary: NO
Ingredient: KEROSENE
Ingredient Sequence Number: 04
Percent: UNKNOWN
NIOSH (RTECS) Number: OA5500000
CAS Number: 8008-20-6
OSHA PEL: 100 PPM
ACGIH TLV: 100 PPM 9091
Other Recommended Limit: NONE SPECIFIED

Proprietary: NO
Ingredient: KEROSENE, HYDRODESULFURIZED
Ingredient Sequence Number: 05
Percent: UNKNOWN
NIOSH (RTECS) Number: 1002450KE
CAS Number: 64742-81-0
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE SPECIFIED
-------------------------------------
Proprietary: NO
Ingredient: LIGHT HYDROCARBON BLEND
Ingredient Sequence Number: 06
Percent: UNKNOWN
NIOSH (RTECS) Number: 1004286BL
CAS Number: 64741-59-9
OSHA PEL: NOT ESTABLISHED
ACGIH TLV: NOT ESTABLISHED
Other Recommended Limit: NONE SPECIFIED
-------------------------------------
Proprietary: NO
Ingredient: NAPHTHALENE (SARA III)
Ingredient Sequence Number: 07
Percent: <3.0
NIOSH (RTECS) Number: QJ0525000
CAS Number: 91-20-3
OSHA PEL: 10 PPM/15 STEL
ACGIH TLV: 10 PPM/15 STEL; 9192
Other Recommended Limit: NONE SPECIFIED

Physical/Chemical Characteristics

Appearance And Odor: PALE YELLOW LIQUID
Boiling Point: 348F, 176C
Melting Point: UNKNOWN
Vapor Pressure (MM Hg/70 F): 0.4 PSIA
Vapor Density (Air=1): UNKNOWN
Specific Gravity: 0.84
Decomposition Temperature: UNKNOWN
Evaporation Rate And Ref: UNKNOWN
Solubility In Water: NEGLIGIBLE
Viscosity: 1.9 CST @ 40C
Corrosion Rate (IPY): UNKNOWN

Fire and Explosion Hazard Data

Flash Point: 125F, 52C
Flash Point Method: PMCC
Lower Explosive Limit: 0.6 %
Upper Explosive Limit: 4.7 %
Extinguishing Media: WATER FOG, DRY CHEMICAL, FOAM, OR CARBON DIOXIDE.
Special Fire Fighting Proc: WEAR SELF-CONTAINED BREATHING APPARATUS AND FULL PROTECTIVE GEAR. USE WATER FOG TO COOL FIRE EXPOSED CONTAINERS AND TO DISPERSE VAPORS.
Unusual Fire And Explosive Hazards: COMBUSTIBLE LIQUID. ISOLATE FROM SOURCES OF IGNITION.

-------------------------------------
Reactivity Data
-------------------------------------
Stability: YES
Cond To Avoid (Stability): HEAT, FLAME AND OTHER SOURCES OF IGNITION.
Materials To Avoid: STRONG OXIDIZING AGENTS.
Hazardous Decomposition Products: OXIDES OF CARBON.
Hazardous Poly Occur: NO
Conditions To Avoid (Poly): NONE

-------------------------------------
Health Hazard Data
-------------------------------------
LD50-LC50 Mixture: ORAL LD50 (RAT) IS 9.0 ML/KG
Route of Entry - Inhalation: YES
Route of Entry - Skin: YES
Route of Entry - Ingestion: NO
Health Haz Acute And Chronic: ACUTE: INHALATION- NARCOSIS OR DROWSINESS. EYES- IRRITATION. SKIN- SEVERE IRRITATION. BURNS AND BLISTERING. INGESTION-MANUFACTURER STATES POSSIBLE CANCER OR KIDNEY DAMAGE.
Carcinogenicity - NTP: NO
Carcinogenicity - IARC: NO
Carcinogenicity - OSHA: NO
Explanation Carcinogenicity: MANUFACTURER STATES POSSIBLE CARCINOGEN FROM "MIDDLE DISTILLATES". BURNING SENSATION, REDNESS. SKIN: BURNS, RASH, BLISTERS. INGESTION: BURNING OF MOUTH AND ESOPHAGUS. NAUSEA, VOMITING, STOMACH PAIN.
Med Cond Aggravated By Exp: PRE-EXISTING SKIN DISORDERS MAY BE AGGRAVATED BY EXPOSURE.
Emergency/First Aid Proc: INHALATION: REMOVE TO FRESH AIR. IF NOT BREATHING, GIVE ARTIFICIAL RESPIRATION. EYES: FLUSH WITH PLENTY OF WATER FOR 15 MINUTES. SEE DOCTOR. SKIN: WASH WITH SOAP AND WATER. INGESTION: DO NOT INDUCE VOMITING! SEE DOCTOR. SEE DOCTOR IF ANY SYMPTOMS PERSIST.

-------------------------------------
Precautions for Safe Handling and Use
-------------------------------------
Steps If Material Released/Spill: CONTAIN SPILL. ABSORB ON SUITABLE MATERIAL, SCOOP UP AND PLACE IN CONTAINER FOR DISPOSAL. VENTILATE AREA. USE SELF-CONTAINED BREATHING APPARATUS IN CONFINED AREA. ELIMINATE SOURCES OF IGNITION FROM SPILL AREA.
Neutralizing Agent: NONE
Waste Disposal Method: IF DISCARDED IN ORIGINAL FORM, DISPOSE OF AS AN IGNITABLE MATERIAL (D001) UNDER RCRA. OTHERWISE CONTACT LOCAL ENVIRONMENTAL MANAGER AND DISPOSE OF IN
ACCORDANCE WITH LOCAL, STATE AND FEDERAL REGULATIONS.
Precautions-Handling/Storing: STORE AWAY FROM HEAT AND IGNITION SOURCES. HANDLE AND STORE IN ACCORDANCE WITH OSHA REG. 1910.106.
Other Precautions: USE ONLY AS A FUEL. NOT FOR USE AS PORTABLE HEATER OR APPLIANCE FUEL. TOXIC FUMES MAY ACCUMULATE AND CAUSE DEATH.

---

**Control Measures**
---

Respiratory Protection: USE SELF-CONTAINED BREATHING APPARATUS IF PEL/TLV EXCEEDED AS IN A LARGE SPILL OR CONFINED AREA.
Ventilation: USE ADEQUATE MECHANICAL VENTILATION.
Protective Gloves: NITRIL, PVA, NEOPRENE
Eye Protection: SAFETY GLASSES/CHEMICAL SPLASH GOGGLES
Other Protective Equipment: NONE SPECIFIED BY MANUFACTURER.
Work Hygienic Practices: USE GOOD PERSONAL HYGIENE. LAUNDER CONTAMINATED CLOTHING BEFORE REUSE.
Suppl. Safety & Health Data: NONE

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**Transportation Data**
---

Trans Data Review Date:  95339
DOT PSN Code: LKZ
DOT Proper Shipping Name: PETROLEUM DISTILLATES, N.O.S. OR PETROLEUM PRODUCTS, N.O.S.
DOT Class: 3
DOT ID Number: UN1268
DOT Pack Group: III
DOT Label: FLAMMABLE LIQUID
IMO PSN Code: LMH
IMO Proper Shipping Name: PETROLEUM DISTILLATES, N.O.S. o
IMO Regulations Page Number: 3375
IMO UN Number: 1268
IMO UN Class: 3.3
IMO Subsidiary Risk Label: -
IATA PSN Code: TJB
IATA UN ID Number: 1268
IATA Proper Shipping Name: PETROLEUM DISTILLATES, N.O.S.
IATA UN Class: 3
IATA Label: FLAMMABLE LIQUID
AFI PSN Code: TJB
AFI Prop. Shipping Name: PETROLEUM DISTILLATES, N.O.S.
AFI Class: 3
AFI ID Number: UN1268
AFI Pack Group: III
AFI Basic Pac Ref: A7.3
N.O.S. Shipping Name: HYDRODESULFURIZED MIDDLE DISTILLATE, STRAIGHT RUN MIDDLE DISTILLATES

Disposal Data

Label Data

Label Required: YES
Label Status: G
Common Name: CHEVRON DIESEL FUEL NO. 2
Label Name: CHEVRON ENVIRONMENTAL HEALTH CENTER INC.
Label Street: 15299 SAN PABLO AVE.
Label P.O. Box: 4054
Label City: RICHMOND
Label State: CA
Label Zip Code: 94804-0054
Label Country: US
Label Emergency Number: 415-233-3737
SMALL GROUP ACTIVITY — Scenario Two

Preparing a Confined Space Entry Permit:
The Fertilizer Plant

As a group, fill out the Confined Space Entry Permit for the work described below. You (the group) are the entry supervisor at the fertilizer plant where the entry is being done. You have to decide how many entrants are needed, the best personal protective equipment for the job, and the communications and rescue/retrieve equipment needed.

Repairs Inside a Fertilizer Storage Tank

An outdoor storage tank holds fertilizer slurry containing anhydrous ammonia. The tank has been cleaned so repairs can be carried out. Two carpenters must enter the empty fertilizer storage tank to set up wooden scaffolding for a team of workers.

Entry to the tank is through two 18-inch manholes. When one scaffold is fully set up, the workers will enter the tank to change valves. The repairs will involve welding and cutting. While the team works, the carpenters will set up a second scaffold next to the first one.

Portable electric lighting is needed to illuminate the space. Since the tank is outside and it’s winter, hot air is blown into the tank to dilute and warm the air. The air is warmed by a propane-fired heater operating outside the tank.

Air monitoring in the tank shows these results:

- Oxygen = 20.6%
- Percent of the LEL = 1%
- Ammonia = 50 ppm

Please note that a detector tube was used for the ammonia. Detector tubes can be “off” by up to 25%, so the ammonia could be as low at 38 ppm or as high as 62 ppm.

Use your NIOSH Pocket Guide to research ammonia.
SMALL GROUP ACTIVITY — Scenario Three

Preparing a Confined Space Entry Permit: The Grain Processing Plant

As a group, fill out the Confined Space Entry Permit for the work described below. You (the group) are the entry supervisor at the grain processing plant where the work is being done. You have to decide how many entrants are needed, the personal protective equipment required and the type of communications and rescue/retrieval equipment that would be best for the job.

Conveyor Maintenance at Grain Processing Plant

Two workers at a grain processing plant must enter an underground shaft to fix and realign a broken conveyer. The entry to the conveyer lies beneath a hopper, which is fully loaded with grain. A gear has broken and must be replaced. To replace the gear, the belt must be dismantled, several other gears must be removed, and the conveyer drive chain disengaged. When the repair is completed, the conveyer belt must be realigned.

The work will take place underneath the hopper chute, where grain enters the conveyer line. There is no natural air movement at the bottom of the conveyer shaft. Over the years, the walls of the shaft have begun to rust. The walls and floor are coated with a fine layer of grain dust, which is easily stirred up by walking. Portable electric lighting is needed to illuminate the work area.

Air monitoring in the work area shows these results:

- Oxygen = 17.1%
- Percent of the LEL = 0%
- Non-specific air contaminants = 1 ppm
NOTES and SCRIBBLES
This chapter looks at the requirements for rescue and emergency services under the OSHA Permit-Required Confined Space Standard, paragraph (k).

Employers may use their own specially-trained employees as rescuers or they may contract with an outside emergency service provider. An outside contract rescue service has to be pretty close and pretty fast to be of much use — people can go only four to six minutes without oxygen before brain damage begins.

If your employer has its own in-house rescue team (k)(2), that team must:

1. **Be given the PPE** (personal protective equipment) and rescue equipment which is needed for permit space rescues. The team must be trained in the proper use of this equipment. (k)(2)(i)

2. **Be trained** to perform the duties they are assigned. They must also be trained as permit space entrants (see Chapter Eight). (k)(2)(ii)

3. **Practice** confined space rescue at least once every 12 months. The practice must be a simulated rescue operation from the actual permit spaces or from “representative” permit spaces which have the same characteristics as the “real” permit-spaces. The team needs to practice removing dummies, manikins, or real people from the permit space. (k)(2)(iv)

4. Each member of the rescue team must be trained in basic first aid and CPR. At least one member certified in first-aid/CPR must be available. (k)(2)(iii)
If your employer uses an outside contractor to provide emergency services, your employer must give the contractor access to all the permit spaces so the contractor can develop and practice rescue plans (k)(1)(v).

Retrieval systems to facilitate non-entry rescue are covered in paragraph (k)(3) of the OSHA PRCS Standard:

- Retrieval systems/equipment must be used for each permit space entry unless the equipment itself increases the risk or wouldn’t help rescue the entrant (k)(3).

- Each entrant must use a chest or full body harness. The retrieval line must be attached at the center of the entrant’s back near shoulder level, and above the entrant's head or at another point which the employer can establish presents a profile small enough for the successful removal of the entrant (k)(3)(i).

- The other end of the retrieval line must be attached to a mechanical device (or fixed point) outside the permit space. Rescue must be able to start immediately if it is needed. The equipment must be ready to use when the entry begins. A mechanical device shall be available to retrieve personnel from vertical type permit-spaces more than 5 feet deep (k)(3)(ii).

- Wristlets may be used instead of the chest or full body harness. To use wristlets the employer must show that it’s not feasible to use a harness, that wearing a harness increases the hazard or that wristlets are the “safest and most effective alternative.”

- If an injured entrant in exposed to a substance for which a MSDS is kept on the work site, that MSDS shall be made available to the medical facility treating the exposed entrant (k)(4).

CPWR believes that only full-body harnesses should be worn by confined space entrants. Full-body harnesses help keep the body in an upright position. Anything other than a full-body harness permits an unconscious
body to bend in awkward positions, making spinal, internal, or external bruising possible.

CPWR hopes that no worker is ever asked to enter a space from which the “safest” retrieval method is a pair of wristlets! Retrieving an entrant by straps attached to their wrists can lead to broken wrists, arms, or shoulders.

Retrieval Equipment

Approximately one-third of confined space fatalities are would-be rescuers who enter the confined space without adequate PPE or training. The ability to rescue injured entrants from outside the space is crucial.

Confined space entrants must have fall protection as well as a mechanical retrieval system mentioned above. The best mechanical devices are those which combine fall arrest with retrieval. These devices generally consist of a tripod with a personnel winch and a retractable lifeline for fall arrest which also raises and lowers the entrant.

Several different companies make rescue/retrieval systems. Most systems have a maximum working load of between 300 and 350 pounds. Retractable lifelines should limit a free fall distance to two feet or less. These lifelines need to be able to sustain a (tensile) load of 3,000 pounds. Lifelines which do not limit the free fall to two feet need to be capable of sustaining 5,000 pounds. The manufacturer’s technical information will list these specifications and others including arresting force, type, speed of braking system, cable tension, and the materials of all components.

If a tripod cannot be used on a particular confined space, the rescue and recovery units can be mounted on a davit arm system or a wall unit or truck.
Whenever you work with a rescue/retrieval system during confined space work, it’s good practice to check for the following features:

- The D-ring on your full-body harness should be a sliding D-ring. This helps keep your body upright.

- Self-locking carabiners or snap hooks are used to attach the retractable lifeline to the sliding D-ring of your harness. Carabiners also attach the pulleys to the tripod. Carabiners must be self-locking and rated for 5,000
pounds. Never use rock-climber’s carabiners; they are not self-locking.

- Snaphooks must be self-closing and self-locking with keepers that stay closed and locked until unlocked and pressed open. There are also non-locking but self-closing snaphooks which stay closed until pressed. These should never be used and are illegal for use in fall protection as of January 1, 1998.

- Winches must be personnel winches, not work winches which are used for tools and equipment.

- Pulleys should be wide enough (at least three inches) so there is no damage to the lifeline.

The trained people who operate the equipment are the most important part of any rescue/retrieval system. Practice setting up, inspecting and using the equipment. Raise and lower a healthy entrant until you are confident that you will be able to handle an injured or unconscious one. All attendants should be able to rescue an injured entrant quickly and safely.

To help ensure that a rescue team or service is operating at acceptable levels, OSHA’s Permit-Required Confined Space Standard provides employers with **Appendix F – Rescue Team or Rescue Service Evaluation Criteria**.

Appendix F calls for an **initial evaluation** (ten [10] criteria covering training, equipment, and response time) of rescue teams and services and a **performance evaluation** (ten [10] criteria for rating a team’s or service’s performance during an actual or practice rescue).
SMALL GROUP ACTIVITY

Confined Space Entry and Rescue

Your employer has been hired by a medium-sized paint producer to inspect several storage tanks and reaction vessels. As a supervisor you (the group), have to make decisions about confined space entry procedures. One tank that needs inspection is a toluene storage tank. The tank is 20’ tall and 10’ in diameter, and has a floor that slopes toward a center drain. The top hatch is three feet in diameter. (Hint: Your NIOSH Pocket Guide will help.)

In your groups answer the following questions.

1. What hazards or potential hazards exist in this situation? (Chapter 1)

2. What do you need to do to isolate this space? (Chapter 5)

3. What information do you need about the atmosphere in the tank? (Chapter 2)

What atmospheric conditions would you consider acceptable for entry?
4. As the entry supervisor, what rescue/retrieval equipment would you use for this toluene tank entry? [See (k)(3).]

5. The paint company has its own in-plant rescue service. What training must this rescue team have to comply with the Standard? [See (k).]

6. The paint company is thinking of changing from an in-house rescue team to an outside contractor. What concerns do you have about the paint company using an outside contractor for rescue services? [See (k)(1) and App. F]
SIMULATOR ENTRY & RETRIEVAL PRACTICE
This chapter is a reference chapter because it contains three of the four most important OSHA Standards for confined space worker protection: 1926.21 (Safety Training and Education); 1910.146 (Permit-required Confined Spaces); and 1910.147 (Control of Hazardous Energy (lockout/tagout). Respiratory protection as provided for workers by 1910.134 is not reproduced in this manual. Finally, 1926.416 (General Requirements) and 1926.417 (Lockout and tagging of circuits) are also included.

Other OSHA standards address specific confined space concerns for work particular to that standard, including 29 CFR 1915 (Maritime). Some of these standards are:

- Ventilation and Protection in Welding, Cutting, and heating: 29 CFR 1926.353
- Excavations, Trenching, and Shoring: 29 CFR 1926.651
- Underground Construction: 29 CFR 1926.800
- Underground Lines: 29 CFR 1926.956
- Telecommunications: 29 CFR 1910.268

Open surface Tanks: 29 CFR 1910.94; and

Welding: 29 CFR 1910.252

Each standard in this chapter contains all appendices. A few of the standards contain a sample of Letters of Interpretation issued by OSHA and are provided for illustrative purposes only.

A guide to reading an OSHA standard is provided below, as well as a brief exercise (next few pages) to hone your searching skills.

THE STANDARD OUTLINE

All OSHA Standards are composed of paragraphs. These paragraphs begin with small letters (a), (b), (c), and etc.

For example, the 29 CFR 1910.146 contains paragraphs (a) through (l). Paragraph (l) was added to the standard in 1998.

Sub-sections to the paragraphs begin with regular (Arabic) numbers (1), (2), (3), and etc.

For example, 29 CFR 1910.146 (c) has sub-sections (1) through (9).

Sub-sections of the numbered sub-sections begin with lower case Roman numerals (i), (ii), (iii), and etc.

For example, 29 CFR 1910.146 (c)(7) has sub-sections (i) through (iv).

When the Roman numeral sub-sections have sub-sections, they begin with capital letters (A), (B), (C), and etc.

For example, 29 CFR 1910.146 (c)(5)(i) has sub-sections (A) - (F).
SMALL GROUP ACTIVITY

The OSHA Permit-Required Confined Space Standard 1910.146

1. At a refinery in New Jersey, the permit space attendant is a security guard. She has received attendant’s training. The attendant/guard sits at a console and can watch up to five permit space entries at one time.

Do you think this arrangement is in compliance with (d)(6)? Explain your answer.

2. An entrant, Doug Jones, and an attendant, Steve Hernandez, have been shown a 15-minute video on the generic hazards of confined spaces. They are now assigned a permit space entry job.

Is this training adequate? Make a list of problems you find with the training given Doug and Steve. See paragraphs (g), (h) and (i).
3. The space Doug is to enter is located on the ground floor and extends 12’ below floor level. It has steeply converging sides. It has been ventilated and monitored. The atmosphere is within acceptable limits. Doug is supposed to inspect the steel lining of the space, and note any weaknesses, dents, etc. that may need repair. The entry permit, posted near the space, is signed by the supervisor, lists Doug and Steve by name, lists monitoring results, the name of the outside emergency rescue contractor, and states that the permit is good for six months.

According to paragraphs (e) and (f) is this permit in compliance? Explain your answer.

4. Doug is given a chest harness. A retrieval line is attached to the front center of the harness. The other end of the line is tied off to the nearest beam and is within Steve’s reach.

Make a list of problems you see with this arrangement. Use Chapter Nine of your manual and paragraph (k).
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A trainer writes:

“In 1926 Subpart J, Welding and Cutting, 1926.353 (b) Welding, cutting, and heating in confined spaces (b)(2) states:

When sufficient ventilation cannot be obtained without blocking the means of access, employees in the confined space shall be protected by an airline respirator.

Our contractors often bypass this provision and most of our members are not aware this standard exists. The welding and cutting provision in 1910 covers this situation but I think it is important to make the workers aware this provision is also in the construction standard...95% of our members work in a confined space....”
OSHA Regulations (Standards - 29 CFR)
Safety training and education - 1926.21*

(a) General requirements. The Secretary shall, pursuant to section 107(f) of the Act, establish and supervise programs for the education and training of employers and employees in the recognition, avoidance and prevention of unsafe conditions in employments covered by the act.

(b) Employer responsibility.

(b)(1) The employer should avail himself of the safety and health training programs the Secretary provides.

(b)(2) The employer shall instruct each employee in the recognition and avoidance of unsafe conditions and the regulations applicable to his work environment to control or eliminate any hazards or other exposure to illness or injury.

(b)(3) Employees required to handle or use poisons, caustics, and other harmful substances shall be instructed regarding the safe handling and use, and be made aware of the potential hazards, personal hygiene, and personal protective measures required.

(b)(4) In job site areas where harmful plants or animals are present, employees who may be exposed shall be instructed regarding the potential hazards,

*Downloaded from www.osha.gov on 8/11/00. Bold type has been added to paragraph headings and other paragraphs cited in this regulation.
and how to avoid injury, and the first aid procedures to be used in the event of injury.

(b)(5)
Employees required to handle or use flammable liquids, gases, or toxic materials shall be instructed in the safe handling and use of these materials and made aware of the specific requirements contained in Subparts D, F, and other applicable subparts of this part.

(b)(6)

(b)(6)(i)
All employees required to enter into confined or enclosed spaces shall be instructed as to the nature of the hazards involved, the necessary precautions to be taken, and in the use of protective and emergency equipment required. The employer shall comply with any specific regulations that apply to work in dangerous or potentially dangerous areas.

(b)(6)(ii)
For purposes of paragraph (b)(6)(i) of this section, "confined or enclosed space" means any space having a limited means of egress, which is subject to the accumulation of toxic or flammable contaminants or has an oxygen deficient atmosphere. Confined or enclosed spaces include, but are not limited to, storage tanks, process vessels, bins, boilers, ventilation or exhaust ducts, sewers, underground utility vaults, tunnels, pipelines, and open top spaces more than 4 feet in depth such as pits, tubs, vaults, and vessels.

e e e
April 12, 1996

BMW Constructors, Inc.
1740 West Michigan St.
PO Box 2210
Indianapolis, Indiana 46222-0210

Dear Sirs:

This is in response to your letter requesting clarification of the Occupational Safety and Health Administration's (OSHA) standards addressing the use of escape only, self-contained breathing apparatus (SCBA) in permit-required confined spaces.

The confined space standard, contained in 29 CFR 1910.146 does not prescribe specific respirators to be used when performing permit required confined space work; instead, respirator selection is determined through compliance with the respirator standards, 29 CFR 1910.134 and 29 CFR 1926.103. Therefore, SCBAs approved for escape may only be used for emergency egress and not for entry or routine work in confined spaces. Respirators required as part of an entry permit must be selected in accordance with the requirements established by either 29 CFR 1910.134 or 1926.103.
In response to your specific questions, the following is provided:

1. Some owners of permit-required confined spaces require that contractors carry ELSA-10 escape SCBA equipment for each worker upon entry into the confined space. These escape SCBAs are simply air bottles with a ten minute air supply connected to a plastic hood. These SCBAs are to be used for emergency egress only and the confined space is of a nature that would not normally require any respiratory protection for workers. Is the possession of this equipment required by the OSHA standards or is this merely a requirement of the confined space owner to suit his own prerogatives?

First, it is important to keep in mind that the host employer that "arranges to have employees of another employer (contractor) perform work that involves permit space entry" has obligations that are spelled out in §§1910.146(c)(8) (host employers). Any additional requirements that the owner may place on you and your employees would be a contract matter between you and the owner.

Since the entering employees in the question you posed would be your employees, you would be considered their employer and it is you that must meet all of the requirements of the confined space standard with respect to them. Those requirements include .146(d)(9) (development and implementation of rescue procedures) and .146(d)(4)(viii) (providing rescue and emergency equipment). If escape-type SCBAs would be necessary for a rescue, then it would be your obligation under the standard to incorporate them in your rescue procedures and make sure that they are provided. Therefore, the answer to your question, "is the possession of this equipment required by the OSHA standards ... ?" is yes if the nature of the circumstances would require that they be provided as part of your rescue procedures.

We cannot be more definitive than this because OSHA did not attempt in the standard to specify the equipment that would be needed for rescues and escapes in every type of permit-required confined space. Instead we have adopted a performance-type standard that requires each employer to determine what equipment would be necessary in the circumstances that they face in each instance.
We do note, though, that the rescue-type SCBA is not sufficient for routine entry or work in a permit space.

2. Are ELSA-10 SCBAs considered respirators under 29 CFR 1926.103? If so, would the requirements of physical examinations apply? If this were the case, would this imply physicals for all workers regardless of whether they normally use respirators in their job duties or not.

Yes, ELSA-10 SCBAs are respirators under 1926.103 (and 1910.134). The standards do not require physical examinations, however. They recommend determination of whether employees are physically able to perform the work and wear the respirators. They require the employer to have a local physician determine what health and physical conditions are pertinent.

[This document was edited on 8/12/99 to strike information that no longer reflects current OSHA policy.]

3. Since 29 CFR 1910.146 does not specifically apply to construction operations, would you provide some guidance on OSHA’s procedures for determining the difference between construction and maintenance operations in relation to this standard, as well as ANSI Z-117-1?

29 CFR 1910.12(b) defines construction work as "work for construction, alteration, and/or repair, including painting and decorating." Generally speaking reconfiguration of space or installation of substantially new equipment is usually considered construction, whereas refurbishing of existing equipment and space is considered maintenance.

Maintenance operations are covered by general industry standards contained in 29 CFR 1910 and construction activities are covered by the construction standards contained in 29 CFR 1926. While paragraph (a), scope and application, of 29 CFR 1910.146 does not apply to construction activities, it does not exclude contractors from coverage when performing maintenance type operations in confined spaces.

Thus, if you are a contractor performing maintenance type activities for a host employer, compliance with 29 CFR 1910.146 is required. Some examples of maintenance operations would be:
The partial patching, total removal of existing lining and replacement, and installation of a new lining in a tank.

The relining of a furnace with new refractory.

Tuck pointing and individual brick replacement in a manhole.

Relining of a sewer line using a sleeve which is pushed through a section of the existing system.

Repainting, which is part of a scheduled program to maintain a system or prevent its deterioration.

For construction activities, hazards not addressed by §§1926.21(b)(6) can be addressed by the general duty clause (Section 5(a)(1) of the Act) based on the requirements of the ANSI standard.

If we can be of any further assistance, please contact me or Mr. Dale Cavanaugh of my staff at (202) 219-8136. Sincerely,

Roy F. Gurnham, P.E., J.D.
Director
Office of Construction Services

Record Type: Interpretation
Standard Number: 1910.146;1926.21;1926.651
Subject: Confined space standard for general industry.
Information Date: 10/08/1993

October 8, 1993

Ms. Suey Howe
Director, Federal Regulations
Associated Builders and Contractors, Inc.
1300 North 17th, 8th Floor
Rosslyn, VA 22204
Dear Ms. Howe:

This is in response to your April 8 letter requesting an interpretation on the scope of the Occupational Safety and Health Administration's (OSHA) confined space standard for general industry. I apologize for the delay in responding to your inquiry.

OSHA's enforcement policy with regard to confined spaces at construction sites has not changed with the promulgation of the general industry regulation. In those instances where a hazard is addressed by an existing part 1926 standard, OSHA will continue to cite the specific standard. In those cases where a hazard is observed that is not addressed by an existing specific construction standard but is addressed in the American National Standards Institute's Z117.1 consensus standard, OSHA will continue to cite under 5(a)(1) of the Act provided the conditions for citing the general duty clause are present. However, in no circumstance would it be appropriate to cite a construction contractor under 1926.21 and 1926.651 for failure to comply with the requirements of the new general industry rule.

If we can be of any further assistance, please contact me or Mr. Dale Cavanaugh at (202) 219-8136.

Sincerely,

Roy F. Gurnham, P.E., Esq.
Director
Office of Construction and Maritime Compliance Assistance

April 8, 1993
Mr. Roy Gurnham, Director
Office of Construction and Maritime Compliance Assistance
Occupational Safety and Health Administration
200 Constitution Avenue, N.W., Room N-3610
Washington, D.C. 20005
Re: 1910.146: Permit-Required Confined Spaces

Dear Roy:

Since the issuance at the confined space standard, Associated Builders and Contractors (ABC) has received numerous inquiries as to the impact of this general industry standard on the operations of construction contractors.

In the interest of providing its members with appropriate guidance, ABC respectfully requests a written interpretation from OSHA regarding the impact of the 1910 confined space standard on the construction industry. Specifically, could OSHA cite a construction contractor as being in violation of 1926.21 and 1926.651, if their safety and training efforts do not comply with the requirements outlined in the 1910 standard? Contractors are concerned that OSHA compliance officers will expect them to follow the 1910 standard in the absence at detailed requirements, i.e. permitting, in the 1926 standards. ABC has advised its members that "maintenance activities" are deemed general industry activities by OSHA. Therefore, contractors performing maintenance must comply with the 1910 standard; however, uncertainty remains regarding the impact of the 1910 standard on their construction activities.

ABC looks forward to receiving a written interpretation from OSHA regarding a construction contractor’s responsibility to adopt components of the 1910 standard in an effort to provide appropriate protection required by 1926.21 and 1926.651, as well as the general duty clause. Should additional information be required, please do not hesitate to contact me.

Sincerely,

Suey Howe
Director, Federal Regulations
OSHA Regulations (Standards - 29 CFR)  
Permit-required confined spaces - 1910.146*

(a)  
Scope and application. This section contains requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces. This section does not apply to agriculture, to construction, or to shipyard employment (Parts 1928, 1926, and 1915 of this chapter, respectively).

(b)  
Definitions.

"Acceptable entry conditions" means the conditions that must exist in a permit space to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter into and work within the space.

"Attendant" means an individual stationed outside one or more permit spaces who monitors the authorized entrants and who performs all attendant's duties assigned in the employer's permit space program.

"Authorized entrant" means an employee who is authorized by the employer to enter a permit space.

"Blanking or blinding" means the absolute closure of a pipe, line, or duct by the fastening of a solid plate (such as a spectacle blind or a skillet blind) that completely covers the bore and that is capable of withstanding the maximum pressure of the pipe, line, or duct with no leakage beyond the plate.

*Downloaded from www.osha.gov on 8/7/00. Bold type has been added to paragraph headings, “definitions”, “note”, other paragraphs cited in this regulation, subparagraphs beginning with a number in parentheses, the appendices, the letters of interpretation, and the Preamble.
"Confined space" means a space that:

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

"Double block and bleed" means the closure of a line, duct, or pipe by closing and locking or tagging two in-line valves and by opening and locking or tagging a drain or vent valve in the line between the two closed valves.

"Emergency" means any occurrence (including any failure of hazard control or monitoring equipment) or event internal or external to the permit space that could endanger entrants.

"Engulfment" means the surrounding and effective capture of a person by a liquid or finely divided (flowable) solid substance that can be aspirated to cause death by filling or plugging the respiratory system or that can exert enough force on the body to cause death by strangulation, constriction, or crushing.

"Entry" means the action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant’s body breaks the plane of an opening into the space.

"Entry permit (permit)" means the written or printed document that is provided by the employer to allow and control entry into a permit space and that contains the information specified in paragraph (f) of this section.

"Entry supervisor" means the person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required by this section.
NOTE: An entry supervisor also may serve as an attendant or as an authorized entrant, as long as that person is trained and equipped as required by this section for each role he or she fills. Also, the duties of entry supervisor may be passed from one individual to another during the course of an entry operation.

"Hazardous atmosphere" means an atmosphere that may expose employees to the risk of death, incapacitation, impairment of ability to self-rescue (that is, escape unaided from a permit space), injury, or acute illness from one or more of the following causes:

(1) Flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit (LFL);
(2) Airborne combustible dust at a concentration that meets or exceeds its LFL;

NOTE: This concentration may be approximated as a condition in which the dust obscures vision at a distance of 5 feet (1.52 m) or less.

(3) Atmospheric oxygen concentration below 19.5 percent or above 23.5 percent;
(4) Atmospheric concentration of any substance for which a dose or a permissible exposure limit is published in Subpart G, Occupational Health and Environmental Control, or in Subpart Z, Toxic and Hazardous Substances, of this Part and which could result in employee exposure in excess of its dose or permissible exposure limit;

NOTE: An atmospheric concentration of any substance that is not capable of causing death, incapacitation, impairment of ability to self-rescue, injury, or acute illness due to its health effects is not covered by this provision.

(5) Any other atmospheric condition that is immediately dangerous to life or health.

NOTE: For air contaminants for which OSHA has not determined a dose or permissible exposure limit, other
sources of information, such as Material Safety Data Sheets that comply with the Hazard Communication Standard, section 1910.1200 of this Part, published information, and internal documents can provide guidance in establishing acceptable atmospheric conditions.

"Hot work permit" means the employer's written authorization to perform operations (for example, riveting, welding, cutting, burning, and heating) capable of providing a source of ignition.

"Immediately dangerous to life or health (IDLH)" means any condition that poses an immediate or delayed threat to life or that would cause irreversible adverse health effects or that would interfere with an individual's ability to escape unaided from a permit space.

NOTE: Some materials -- hydrogen fluoride gas and cadmium vapor, for example -- may produce immediate transient effects that, even if severe, may pass without medical attention, but are followed by sudden, possibly fatal collapse 12-72 hours after exposure. The victim "feels normal" from recovery from transient effects until collapse. Such materials in hazardous quantities are considered to be "immediately" dangerous to life or health.

"Inerting" means the displacement of the atmosphere in a permit space by a noncombustible gas (such as nitrogen) to such an extent that the resulting atmosphere is noncombustible.

NOTE: This procedure produces an IDLH oxygen-deficient atmosphere.

"Isolation" means the process by which a permit space is removed from service and completely protected against the release of energy and material into the space by such means as: blanking or blinding; mis-aligning or removing sections of lines, pipes, or ducts; a double block and bleed system; lockout or tag-out of all sources of energy; or blocking or disconnecting all mechanical linkages.

"Line breaking" means the intentional opening of a pipe, line, or duct that is or has been carrying flammable, corrosive, or toxic material, an inert gas,
or any fluid at a volume, pressure, or temperature capable of causing injury.

"Non-permit confined space" means a confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing death or serious physical harm.

"Oxygen deficient atmosphere" means an atmosphere containing less than 19.5 percent oxygen by volume.

"Oxygen enriched atmosphere" means an atmosphere containing more than 23.5 percent oxygen by volume.

"Permit-required confined space (permit space)" means a confined space that has one or more of the following characteristics:

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

"Permit-required confined space program (permit space program)" means the employer's overall program for controlling, and, where appropriate, for protecting employees from, permit space hazards and for regulating employee entry into permit spaces.

"Permit system" means the employer's written procedure for preparing and issuing permits for entry and for returning the permit space to service following termination of entry.

"Prohibited condition" means any condition in a permit space that is not allowed by the permit during the period when entry is authorized.

"Rescue service" means the personnel designated to rescue employees from permit spaces.

"Retrieval system" means the equipment (including a retrieval line, chest
or full-body harness, wristlets, if appropriate, and a lifting device or anchor) used for non-entry rescue of persons from permit spaces.

"Testing" means the process by which the hazards that may confront entrants of a permit space are identified and evaluated. Testing includes specifying the tests that are to be performed in the permit space.

NOTE: Testing enables employers both to devise and implement adequate control measures for the protection of authorized entrants and to determine if acceptable entry conditions are present immediately prior to, and during, entry.

(c) General requirements.

(c)(1) The employer shall evaluate the workplace to determine if any spaces are permit-required confined spaces.

NOTE: Proper application of the decision flow chart in Appendix A to section 1910.146 would facilitate compliance with this requirement.

(c)(2) If the workplace contains permit spaces, the employer shall inform exposed employees, by posting danger signs or by any other equally effective means, of the existence and location of and the danger posed by the permit spaces.

NOTE: A sign reading DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER or using other similar language would satisfy the requirement for a sign.

(c)(3) If the employer decides that its employees will not enter permit spaces, the employer shall take effective measures to prevent its employees from entering the permit spaces and shall comply with paragraphs (c)(1), (c)(2), (c)(6), and (c)(8) of this section.
(c)(4)
If the employer decides that its employees will enter permit spaces, the employer shall develop and implement a written permit space program that complies with this section. The written program shall be available for inspection by employees and their authorized representatives.

(c)(5)
An employer may use the alternate procedures specified in paragraph (c)(5)(ii) of this section for entering a permit space under the conditions set forth in paragraph (c)(5)(i) of this section.

(c)(5)(i)
An employer whose employees enter a permit space need not comply with paragraphs (d) through (f) and (h) through (k) of this section, provided that:

(c)(5)(i)(A)
The employer can demonstrate that the only hazard posed by the permit space is an actual or potential hazardous atmosphere;

(c)(5)(i)(B)
The employer can demonstrate that continuous forced air ventilation alone is sufficient to maintain that permit space safe for entry;

(c)(5)(i)(C)
The employer develops monitoring and inspection data that supports the demonstrations required by paragraphs (c)(5)(i)(A) and (c)(5)(i)(B) of this section;

(c)(5)(i)(D)
If an initial entry of the permit space is necessary to obtain the data required by paragraph (c)(5)(i)(C) of this section, the entry is performed in compliance with paragraphs (d) through (k) of this section;

(c)(5)(i)(E)
The determinations and supporting data required by paragraphs (c)(5)(i)(A), (c)(5)(i)(B), and (c)(5)(i)(C) of this section are documented by the employer and are made available to each employee who enters the permit space under the terms of paragraph (c)(5) of this section or to that
employee's authorized representative; and

(c)(5)(i)(F)
Entry into the permit space under the terms of paragraph (c)(5)(i) of this section is performed in accordance with the requirements of paragraph (c)(5)(ii) of this section.

NOTE: See paragraph (c)(7) of this section for reclassification of a permit space after all hazards within the space have been eliminated.

(c)(5)(ii)
The following requirements apply to entry into permit spaces that meet the conditions set forth in paragraph (c)(5)(i) of this section.

(c)(5)(ii)(A)
Any conditions making it unsafe to remove an entrance cover shall be eliminated before the cover is removed.

(c)(5)(ii)(B)
When entrance covers are removed, the opening shall be promptly guarded by a railing, temporary cover, or other temporary barrier that will prevent an accidental fall through the opening and that will protect each employee working in the space from foreign objects entering the space.

(c)(5)(ii)(C)
Before an employee enters the space, the internal atmosphere shall be tested, with a calibrated direct-reading instrument, for oxygen content, for flammable gases and vapors, and for potential toxic air contaminants, in that order. Any employee who enters the space, or that employee's authorized representative, shall be provided an opportunity to observe the pre-entry testing required by this paragraph.

(c)(5)(ii)(C)(1)
Oxygen content,

(c)(5)(ii)(C)(2)
Flammable gases and vapors, and
(c)(5)(ii)(C)(3)
Potential toxic air contaminants.

(c)(5)(ii)(D)
There may be no hazardous atmosphere within the space whenever any employee is inside the space.

(c)(5)(ii)(E)
Continuous forced air ventilation shall be used, as follows:

(c)(5)(ii)(E)(1)
An employee may not enter the space until the forced air ventilation has eliminated any hazardous atmosphere;

(c)(5)(ii)(E)(2)
The forced air ventilation shall be so directed as to ventilate the immediate areas where an employee is or will be present within the space and shall continue until all employees have left the space;

(c)(5)(ii)(E)(3)
The air supply for the forced air ventilation shall be from a clean source and may not increase the hazards in the space.

(c)(5)(ii)(F)
The atmosphere within the space shall be periodically tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere. Any employee who enters the space, or that employee's authorized representative, shall be provided with an opportunity to observe the periodic testing required by this paragraph.

(c)(5)(ii)(G)
If a hazardous atmosphere is detected during entry:

(c)(5)(ii)(G)(1)
Each employee shall leave the space immediately;

(c)(5)(ii)(G)(2)
The space shall be evaluated to determine how the hazardous atmosphere developed; and
(c)(5)(ii)(G)(3)
Measures shall be implemented to protect employees from the hazardous atmosphere before any subsequent entry takes place.

(c)(5)(ii)(H)
The employer shall verify that the space is safe for entry and that the pre-entry measures required by paragraph (c)(5)(ii) of this section have been taken, through a written certification that contains the date, the location of the space, and the signature of the person providing the certification. The certification shall be made before entry and shall be made available to each employee entering the space or to that employee's authorized representative.

(c)(6)
When there are changes in the use or configuration of a non-permit confined space that might increase the hazards to entrants, the employer shall reevaluate that space and, if necessary, reclassify it as a permit-required confined space.

(c)(7)
A space classified by the employer as a permit-required confined space may be reclassified as a non-permit confined space under the following procedures:

(c)(7)(i)
If the permit space poses no actual or potential atmospheric hazards and if all hazards within the space are eliminated without entry into the space, the permit space may be reclassified as a non-permit confined space for as long as the non-atmospheric hazards remain eliminated.

(c)(7)(ii)
If it is necessary to enter the permit space to eliminate hazards, such entry shall be performed under paragraphs (d) through (k) of this section. If testing and inspection during that entry demonstrate that the hazards within the permit space have been eliminated, the permit space may be reclassified as a non-permit confined space for as long as the hazards remain eliminated.

NOTE: Control of atmospheric hazards through forced air ventilation
does not constitute elimination of the hazards. **Paragraph (c)(5)** covers permit space entry where the employer can demonstrate that forced air ventilation alone will control all hazards in the space.

**(c)(7)(iii)**
The employer shall document the basis for determining that all hazards in a permit space have been eliminated, through a certification that contains the date, the location of the space, and the signature of the person making the determination. The certification shall be made available to each employee entering the space or to that employee's authorized representative.

**(c)(7)(iv)**
If hazards arise within a permit space that has been declassified to a non-permit space under paragraph (c)(7) of this section, each employee in the space shall exit the space. The employer shall then reevaluate the space and determine whether it must be reclassified as a permit space, in accordance with other applicable provisions of this section.

**(c)(8)**
When an employer (host employer) arranges to have employees of another employer (contractor) perform work that involves permit space entry, the host employer shall:

**(c)(8)(i)**
Inform the contractor that the workplace contains permit spaces and that permit space entry is allowed only through compliance with a permit space program meeting the requirements of this section;

**(c)(8)(ii)**
Apprize the contractor of the elements, including the hazards identified and the host employer's experience with the space, that make the space in question a permit space;

**(c)(8)(iii)**
Apprize the contractor of any precautions or procedures that the host employer has implemented for the protection of employees in or near permit spaces where contractor personnel will be working;
(c)(8)(iv)
Coordinate entry operations with the contractor, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and

(c)(8)(v)
Debrief the contractor at the conclusion of the entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operation

(c)(9)
In addition to complying with the permit space requirements that apply to all employers, each contractor who is retained to perform permit space entry operations shall:

(c)(9)(i)
Obtain any available information regarding permit space hazards and entry operations from the host employer;

(c)(9)(ii)
Coordinate entry operations with the host employer, when both host employer personnel and contractor personnel will be working in or near permit spaces, as required by paragraph (d)(11) of this section; and

(c)(9)(iii)
Inform the host employer of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces, either through a debriefing or during the entry operation.

(d)
Permit-required confined space program (permit space program). Under the permit space program required by paragraph (c)(4) of this section, the employer shall:

(d)(1)
Implement the measures necessary to prevent unauthorized entry;

(d)(2)
Identify and evaluate the hazards of permit spaces before employees enter
(d)(3) Develop and implement the means, procedures, and practices necessary for safe permit space entry operations, including, but not limited to, the following:

(d)(3)(i) Specifying acceptable entry conditions;

(d)(3)(ii) Providing each authorized entrant or that employee's authorized representative with the opportunity to observe any monitoring or testing of permit spaces;

(d)(3)(iii) Isolating the permit space;

(d)(3)(iv) Purging, inerting, flushing, or ventilating the permit space as necessary to eliminate or control atmospheric hazards;

(d)(3)(v) Providing pedestrian, vehicle, or other barriers as necessary to protect entrants from external hazards; and

(d)(3)(vi) Verifying that conditions in the permit space are acceptable for entry throughout the duration of an authorized entry.

(d)(4) Provide the following equipment (specified in paragraphs (d)(4)(i) through (d)(4)(ix) of this section) at no cost to employees, maintain that equipment properly, and ensure that employees use that equipment properly:

(d)(4)(i) Testing and monitoring equipment needed to comply with paragraph (d)(5) of this section;
(d)(4)(ii)
Ventilating equipment needed to obtain acceptable entry conditions;

(d)(4)(iii)
Communications equipment necessary for compliance with paragraphs (h)(3) and (i)(5) of this section;

(d)(4)(iv)
Personal protective equipment insofar as feasible engineering and work practice controls do not adequately protect employees;

(d)(4)(v)
Lighting equipment needed to enable employees to see well enough to work safely and to exit the space quickly in an emergency;

(d)(4)(vi)
Barriers and shields as required by paragraph (d)(3)(iv) of this section;

(d)(4)(vii)
Equipment, such as ladders, needed for safe ingress and egress by authorized entrants;

(d)(4)(viii)
Rescue and emergency equipment needed to comply with paragraph (d)(9) of this section, except to the extent that the equipment is provided by rescue services; and

(d)(4)(ix)
Any other equipment necessary for safe entry into and rescue from permit spaces.

(d)(5)
Evaluate permit space conditions as follows when entry operations are conducted:

(d)(5)(i)
Test conditions in the permit space to determine if acceptable entry conditions exist before entry is authorized to begin, except that, if isolation of the space is infeasible because the space is large or is part of a
continuous system (such as a sewer), pre-entry testing shall be performed to the extent feasible before entry is authorized and, if entry is authorized, entry conditions shall be continuously monitored in the areas where authorized entrants are working;

(d)(5)(ii)
Test or monitor the permit space as necessary to determine if acceptable entry conditions are being maintained during the course of entry operations; and

(d)(5)(iii)
When testing for atmospheric hazards, test first for oxygen, then for combustible gases and vapors, and then for toxic gases and vapors.

(d)(5)(iv)
Provide each authorized entrant or that employee's authorized representative an opportunity to observe the pre-entry and any subsequent testing or monitoring of permit spaces;

(d)(5)(v)
Reevaluate the permit space in the presence of any authorized entrant or that employee's authorized representative who requests that the employer conduct such reevaluation because the entrant or representative has reason to believe that the evaluation of that space may not have been adequate;

(d)(5)(vi)
Immediately provide each authorized entrant or that employee's authorized representative with the results of any testing conducted in accord with paragraph (d) of this section.

NOTE: Atmospheric testing conducted in accordance with Appendix B to section 1910.146 would be considered as satisfying the requirements of this paragraph. For permit space operations in sewers, atmospheric testing conducted in accordance with Appendix B, as supplemented by Appendix E to section 1910.146, would be considered as satisfying the requirements of this paragraph.
(d)(6) Provide at least one attendant outside the permit space into which entry is authorized for the duration of entry operations;

NOTE: Attendants may be assigned to monitor more than one permit space provided the duties described in paragraph (i) of this section can be effectively performed for each permit space that is monitored. Likewise, attendants may be stationed at any location outside the permit space to be monitored as long as the duties described in paragraph (i) of this section can be effectively performed for each permit space that is monitored.

(d)(7) If multiple spaces are to be monitored by a single attendant, include in the permit program the means and procedures to enable the attendant to respond to an emergency affecting one or more of the permit spaces being monitored without distraction from the attendant's responsibilities under paragraph (i) of this section;

(d)(8) Designate the persons who are to have active roles (as, for example, authorized entrants, attendants, entry supervisors, or persons who test or monitor the atmosphere in a permit space) in entry operations, identify the duties of each such employee, and provide each such employee with the training required by paragraph (g) of this section;

(d)(9) Develop and implement procedures for summoning rescue and emergency services, for rescuing entrants from permit spaces, for providing necessary emergency services to rescued employees, and for preventing unauthorized personnel from attempting a rescue;

(d)(10) Develop and implement a system for the preparation, issuance, use, and cancellation of entry permits as required by this section;

(d)(11) Develop and implement procedures to coordinate entry operations when employees of more than one employer are working simultaneously as
authorized entrants in a permit space, so that employees of one employer do not endanger the employees of any other employer;

(d)(12)
Develop and implement procedures (such as closing off a permit space and canceling the permit) necessary for concluding the entry after entry operations have been completed;

(d)(13)
Review entry operations when the employer has reason to believe that the measures taken under the permit space program may not protect employees and revise the program to correct deficiencies found to exist before subsequent entries are authorized; and

**NOTE:** Examples of circumstances requiring the review of the permit space program are: any unauthorized entry of a permit space, the detection of a permit space hazard not covered by the permit, the detection of a condition prohibited by the permit, the occurrence of an injury or near-miss during entry, a change in the use or configuration of a permit space, and employee complaints about the effectiveness of the program.

(d)(14)
Review the permit space program, using the canceled permits retained under paragraph (e)(6) of this section within 1 year after each entry and revise the program as necessary, to ensure that employees participating in entry operations are protected from permit space hazards.

**NOTE:** Employers may perform a single annual review covering all entries performed during a 12-month period. If no entry is performed during a 12-month period, no review is necessary. Appendix C to section 1910.146 presents examples of permit space programs that are considered to comply with the requirements of paragraph (d) of this section.

(e)
Permit system.
(e)(1) Before entry is authorized, the employer shall document the completion of measures required by paragraph (d)(3) of this section by preparing an entry permit.

 **NOTE:** Appendix D to section 1910.146 presents examples of permits whose elements are considered to comply with the requirements of this section.

(e)(2) Before entry begins, the entry supervisor identified on the permit shall sign the entry permit to authorize entry.

(e)(3) The completed permit shall be made available at the time of entry to all authorized entrants or their authorized representatives, by posting it at the entry portal or by any other equally effective means, so that the entrants can confirm that pre-entry preparations have been completed.

(e)(4) The duration of the permit may not exceed the time required to complete the assigned task or job identified on the permit in accordance with paragraph (f)(2) of this section.

(e)(5) The entry supervisor shall terminate entry and cancel the entry permit when:

(e)(5)(i) The entry operations covered by the entry permit have been completed; or

(e)(5)(ii) A condition that is not allowed under the entry permit arises in or near the permit space.

(e)(6) The employer shall retain each canceled entry permit for at least 1 year to facilitate the review of the permit-required confined space program required
by paragraph (d)(14) of this section. Any problems encountered during an entry operation shall be noted on the pertinent permit so that appropriate revisions to the permit space program can be made.

(f)

Entry permit. The entry permit that documents compliance with this section and authorizes entry to a permit space shall identify:

(f)(1)
The permit space to be entered;

(f)(2)
The purpose of the entry;

(f)(3)
The date and the authorized duration of the entry permit;

(f)(4)
The authorized entrants within the permit space, by name or by such other means (for example, through the use of rosters or tracking systems) as will enable the attendant to determine quickly and accurately, for the duration of the permit, which authorized entrants are inside the permit space;

NOTE: This requirement may be met by inserting a reference on the entry permit as to the means used, such as a roster or tracking system, to keep track of the authorized entrants within the permit space.

(f)(5)
The personnel, by name, currently serving as attendants;

(f)(6)
The individual, by name, currently serving as entry supervisor, with a space for the signature or initials of the entry supervisor who originally authorized entry;

(f)(7)
The hazards of the permit space to be entered;
(f)(8) The measures used to isolate the permit space and to eliminate or control permit space hazards before entry;

**NOTE:** Those measures can include the lockout or tagging of equipment and procedures for purging, inerting, ventilating, and flushing permit spaces.

(f)(9) The acceptable entry conditions;

(f)(10) The results of initial and periodic tests performed under paragraph (d)(5) of this section, accompanied by the names or initials of the testers and by an indication of when the tests were performed;

(f)(11) The rescue and emergency services that can be summoned and the means (such as the equipment to use and the numbers to call) for summoning those services;

(f)(12) The communication procedures used by authorized entrants and attendants to maintain contact during the entry;

(f)(13) Equipment, such as personal protective equipment, testing equipment, communications equipment, alarm systems, and rescue equipment, to be provided for compliance with this section;

(f)(14) Any other information whose inclusion is necessary, given the circumstances of the particular confined space, in order to ensure employee safety; and

(f)(15) Any additional permits, such as for hot work, that have been issued to authorize work in the permit space.
(g) Training.

(g)(1) The employer shall provide training so that all employees whose work is regulated by this section acquire the understanding, knowledge, and skills necessary for the safe performance of the duties assigned under this section.

(g)(2) Training shall be provided to each affected employee:

(g)(2)(i) Before the employee is first assigned duties under this section;

(g)(2)(ii) Before there is a change in assigned duties;

(g)(2)(iii) Whenever there is a change in permit space operations that presents a hazard about which an employee has not previously been trained;

(g)(2)(iv) Whenever the employer has reason to believe either that there are deviations from the permit space entry procedures required by paragraph (d)(3) of this section or that there are inadequacies in the employee's knowledge or use of these procedures.

(g)(3) The training shall establish employee proficiency in the duties required by this section and shall introduce new or revised procedures, as necessary, for compliance with this section.

(g)(4) The employer shall certify that the training required by paragraphs (g)(1) through (g)(3) of this section has been accomplished. The certification shall contain each employee's name, the signatures or initials of the trainers, and the dates of training. The certification shall be available for inspection by employees and their authorized representatives.
(h) **Duties of authorized entrants.** The employer shall ensure that all authorized entrants:

**(h)(1)**
Know the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

**(h)(2)**
Properly use equipment as required by paragraph (d)(4) of this section;

**(h)(3)**
 Communicate with the attendant as necessary to enable the attendant to monitor entrant status and to enable the attendant to alert entrants of the need to evacuate the space as required by paragraph (i)(6) of this section;

**(h)(4)**
Alert the attendant whenever:

**(h)(4)(i)**
The entrant recognizes any warning sign or symptom of exposure to a dangerous situation, or

**(h)(4)(ii)**
The entrant detects a prohibited condition; and

**(h)(5)**
Exit from the permit space as quickly as possible whenever:

**(h)(5)(i)**
An order to evacuate is given by the attendant or the entry supervisor,

**(h)(5)(ii)**
The entrant recognizes any warning sign or symptom of exposure to a dangerous situation,

**(h)(5)(iii)**
The entrant detects a prohibited condition, or

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(h)(5)(iv)
An evacuation alarm is activated.

(i)
Duties of attendants. The employer shall ensure that each attendant:

(i)(1)
Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

(i)(2)
Is aware of possible behavioral effects of hazard exposure in authorized entrants;

(i)(3)
Continuously maintains an accurate count of authorized entrants in the permit space and ensures that the means used to identify authorized entrants under paragraph (f)(4) of this section accurately identifies who is in the permit space;

(i)(4)
Remains outside the permit space during entry operations until relieved by another attendant;

NOTE: When the employer's permit entry program allows attendant entry for rescue, attendants may enter a permit space to attempt a rescue if they have been trained and equipped for rescue operations as required by paragraph (k)(1) of this section and if they have been relieved as required by paragraph (i)(4) of this section.

(i)(5)
Communicates with authorized entrants as necessary to monitor entrant status and to alert entrants of the need to evacuate the space under paragraph (i)(6) of this section;

(i)(6)
Monitors activities inside and outside the space to determine if it is safe for entrants to remain in the space and orders the authorized entrants to evacuate the permit space immediately under any of the following
conditions;

(i)(6)(i)
If the attendant detects a prohibited condition;

(i)(6)(ii)
If the attendant detects the behavioral effects of hazard exposure in an authorized entrant;

(i)(6)(iii)
If the attendant detects a situation outside the space that could endanger the authorized entrants; or

(i)(6)(iv)
If the attendant cannot effectively and safely perform all the duties required under paragraph (i) of this section;

(i)(7)
Summon rescue and other emergency services as soon as the attendant determines that authorized entrants may need assistance to escape from permit space hazards;

(i)(8)
Takes the following actions when unauthorized persons approach or enter a permit space while entry is underway:

(i)(8)(i)
Warn the unauthorized persons that they must stay away from the permit space;

(i)(8)(ii)
Advise the unauthorized persons that they must exit immediately if they have entered the permit space; and

(i)(8)(iii)
Inform the authorized entrants and the entry supervisor if unauthorized persons have entered the permit space;
(i)(9) Performs non-entry rescues as specified by the employer's rescue procedure; and

(i)(10) Performs no duties that might interfere with the attendant's primary duty to monitor and protect the authorized entrants.

(j) **Duties of entry supervisors.** The employer shall ensure that each entry supervisor:

(j)(1) Knows the hazards that may be faced during entry, including information on the mode, signs or symptoms, and consequences of the exposure;

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

(j)(3) Terminates the entry and cancels the permit as required by paragraph (e)(5) of this section;

(j)(4) Verifies that rescue services are available and that the means for summoning them are operable;

(j)(5) Removes unauthorized individuals who enter or who attempt to enter the permit space during entry operations; and

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

(k)
Rescue and emergency services.

(k)(1)
An employer who designates rescue and emergency services, pursuant to paragraph (d)(9) of this section, shall:

(k)(1)(i)
Evaluate a prospective rescuer's ability to respond to a rescue summons in a timely manner, considering the hazard(s) identified;

Note to paragraph (k)(1)(i): What will be considered timely will vary according to the specific hazards involved in each entry. For example, §§1910.134, Respiratory Protection, requires that employers provide a standby person or persons capable of immediate action to rescue employee(s) wearing respiratory protection while in work areas defined as IDLH atmospheres.

(k)(1)(ii)
Evaluate a prospective rescue service's ability, in terms of proficiency with rescue-related tasks and equipment, to function appropriately while rescuing entrants from the particular permit space or types of permit spaces identified;

(k)(1)(iii)
Select a rescue team or service from those evaluated that:

(k)(1)(iii)(A)
Has the capability to reach the victim(s) within a time frame that is appropriate for the permit space hazard(s) identified;

(k)(1)(iii)(B)
Is equipped for and proficient in performing the needed rescue services;

(k)(1)(iv)
Inform each rescue team or service of the hazards they may confront when
called on to perform rescue at the site; and

(k)(1)(v)
Provide the rescue team or service selected with access to all permit spaces from which rescue may be necessary so that the rescue service can develop appropriate rescue plans and practice rescue operations.

Note to paragraph (k)(1): Non-mandatory Appendix F contains examples of criteria which employers can use in evaluating prospective rescuers as required by paragraph (k)(1) of this section.

(k)(2)
An employer whose employees have been designated to provide permit space rescue and emergency services shall take the following measures:

(k)(2)(i)
Provide affected employees with the personal protective equipment (PPE) needed to conduct permit space rescues safely and train affected employees so they are proficient in the use of that PPE, at no cost to those employees;

(k)(2)(ii)
Train affected employees to perform assigned rescue duties. The employer must ensure that such employees successfully complete the training required to establish proficiency as an authorized entrant, as provided by paragraphs (g) and (h) of this section;

(k)(2)(iii)
Train affected employees in basic first-aid and cardiopulmonary resuscitation (CPR). The employer shall ensure that at least one member of the rescue team or service holding a current certification in first aid and CPR is available; and

(k)(2)(iv)
Ensure that affected employees practice making permit space rescues at least once every 12 months, by means of simulated rescue operations in which they remove dummies, manikins, or actual persons from the actual permit spaces or from representative permit spaces. Representative permit
spaces shall, with respect to opening size, configuration, and accessibility, simulate the types of permit spaces from which rescue is to be performed.

(k)(3)
To facilitate non-entry rescue, retrieval systems or methods shall be used whenever an authorized entrant enters a permit space, unless the retrieval equipment would increase the overall risk of entry or would not contribute to the rescue of the entrant. Retrieval systems shall meet the following requirements.

(k)(3)(i)
Each authorized entrant shall use a chest or full body harness, with a retrieval line attached at the center of the entrant's back near shoulder level, above the entrant's head, or at another point which the employer can establish presents a profile small enough for the successful removal of the entrant. Wristlets may be used in lieu of the chest or full body harness if the employer can demonstrate that the use of a chest or full body harness is infeasible or creates a greater hazard and that the use of wristlets is the safest and most effective alternative.

(k)(3)(ii)
The other end of the retrieval line shall be attached to a mechanical device or fixed point outside the permit space in such a manner that rescue can begin as soon as the rescuer becomes aware that rescue is necessary. A mechanical device shall be available to retrieve personnel from vertical type permit spaces more than 5 feet (1.52 m) deep.

(k)(4)
If an injured entrant is exposed to a substance for which a Material Safety Data Sheet (MSDS) or other similar written information is required to be kept at the worksite, that MSDS or written information shall be made available to the medical facility treating the exposed entrant.

(l)
Employee participation.

(l)(1)
Employers shall consult with affected employees and their authorized representatives on the development and implementation of all aspects of
the permit space program required by paragraph (c) of this section.

(l)(2)
Employers shall make available to affected employees and their authorized representatives all information required to be developed by this section.


   e e e
Appendix A to §§1910.146 -- Permit-Required Confined Space Decision Flow Chart

Note: Appendices A through F serve to provide information and non-mandatory guidelines to assist employers and employees in complying with the appropriate requirements of this section.

Appendix B to §§1910.146 – Procedures for Atmospheric Testing

Atmospheric testing is required for two distinct purposes: evaluation of the hazards of the permit space and verification that acceptable entry conditions for entry into that space exist.

(1) Evaluation testing. 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 these 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.

(2) Verification testing. The atmosphere of a permit space which may contain a hazardous atmosphere should be tested for residues of all contaminants identified by evaluation testing using permit specified equipment to determine that residual concentrations at the time of testing and entry are within the range of acceptable entry conditions. 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.

(3) Duration of testing. Measurement of values for each atmospheric parameter should be made for at least the minimum response time of the test instrument specified by the manufacturer.

(4) Testing stratified atmospheres. 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.

(5) Order of testing. A test for oxygen is performed first because most combustible gas meters are oxygen dependent and will not provide reliable readings in an oxygen deficient atmosphere. Combustible gases are tested for next because the threat of fire or explosion is both more immediate and more life threatening, in most cases, than exposure to toxic gases and vapors. If tests for toxic gases and vapors are necessary, they are performed last.

[58 FR 4549, Jan. 14, 1993; 58 FR 34846, June 29, 1993]

Standard Number: 1910.146 App C
Standard Title: Examples of Permit-required Confined Space Programs
SubPart Number: J
SubPart Title: General Environmental Controls

Appendix C to §§1910.146 –Examples of Permit-Required Confined Space Programs

EXAMPLE 1.

Workplace. Sewer entry.

Potential hazards. The employees could be exposed to the following: Engulfment.

Presence of toxic gases. Equal to or more than 10 ppm hydrogen sulfide measured as an 8-hour time-weighted average. If the presence of other toxic contaminants is suspected, specific monitoring programs will be developed.
Presence of explosive/flammable gases. Equal to or greater than 10% of the lower flammable limit (LFL).

Oxygen Deficiency. A concentration of oxygen in the atmosphere equal to or less than 19.5% by volume.

A. ENTRY WITHOUT PERMIT/ATTENDANT

Certification. Confined spaces may be entered without the need for a written permit or attendant provided that the space can be maintained in a safe condition for entry by mechanical ventilation alone, as provided in 1910.146(c)(5). All spaces shall be considered permit-required confined spaces until the pre-entry procedures demonstrate otherwise. Any employee required or permitted to pre-check or enter an enclosed/confined space shall have successfully completed, as a minimum, the training as required by the following sections of these procedures. A written copy of operating and rescue procedures as required by these procedures shall be at the work site for the duration of the job. The Confined Space Pre-Entry Check List must be completed by the LEAD WORKER before entry into a confined space. This list verifies completion of items listed below. This check list shall be kept at the job site for duration of the job. If circumstances dictate an interruption in the work, the permit space must be re-evaluated and a new check list must be completed.

Control of atmospheric and engulfment hazards.

Pumps and Lines. All pumps and lines which may reasonably cause contaminants to flow into the space shall be disconnected, blinded and locked out, or effectively isolated by other means to prevent development of dangerous air contamination or engulfment. Not all laterals to sewers or storm drains require blocking. However, where experience or knowledge of industrial use indicates there is a reasonable potential for contamination of air or engulfment into an occupied sewer, then all affected laterals shall be blocked. If blocking and/or isolation requires entry into the space the provisions for entry into a permit-required confined space must be implemented.

Surveillance. The surrounding area shall be surveyed to avoid hazards such as drifting vapors from the tanks, piping, or sewers.
Testing. The atmosphere within the space will be tested to determine whether dangerous air contamination and/or oxygen deficiency exists. Detector tubes, alarm only gas monitors and explosion meters are examples of monitoring equipment that may be used to test permit space atmospheres. Testing shall be performed by the LEAD WORKER who has successfully completed the Gas Detector training for the monitor he will use. The minimum parameters to be monitored are oxygen deficiency, LFL, and hydrogen sulfide concentration. A written record of the pre-entry test results shall be made and kept at the work site for the duration of the job. The supervisor will certify in writing, based upon the results of the pre-entry testing, that all hazards have been eliminated. Affected employees shall be able to review the testing results. The most hazardous conditions shall govern when work is being performed in two adjoining, connecting spaces.

Entry Procedures. If there are no non-atmospheric hazards present and if the pre-entry tests show there is no dangerous air contamination and/or oxygen deficiency within the space and there is no reason to believe that any is likely to develop, entry into and work within may proceed. Continuous testing of the atmosphere in the immediate vicinity of the workers within the space shall be accomplished. The workers will immediately leave the permit space when any of the gas monitor alarm set points are reached as defined. Workers will not return to the area until a SUPERVISOR who has completed the gas detector training has used a direct reading gas detector to evaluate the situation and has determined that it is safe to enter.

Rescue. Arrangements for rescue services are not required where there is no attendant. See the rescue portion of section B, below, for instructions regarding rescue planning where an entry permit is required.

B. ENTRY PERMIT REQUIRED

Permits. Confined Space Entry Permit. All spaces shall be considered permit-required confined spaces until the pre-entry procedures demonstrate otherwise. Any employee required or permitted to pre-check or enter a permit-required confined space shall have successfully completed, as a minimum, the training as required by the following sections of these procedures. A written copy of operating and rescue procedures as required by these procedures shall be at the work site for the duration of the job. The Confined Space Entry Permit must be completed before approval can be given to enter
a permit-required confined space. This permit verifies completion of items listed below. This permit shall be kept at the job site for the duration of the job. If circumstances cause an interruption in the work or a change in the alarm conditions for which entry was approved, a new Confined Space Entry Permit must be completed.

**Control of atmospheric and engulfment hazards.**

**Surveillance.** The surrounding area shall be surveyed to avoid hazards such as drifting vapors from tanks, piping or sewers.

**Testing.** The confined space atmosphere shall be tested to determine whether dangerous air contamination and/or oxygen deficiency exists. A direct reading gas monitor shall be used. Testing shall be performed by the SUPERVISOR who has successfully completed the gas detector training for the monitor he will use. The minimum parameters to be monitored are oxygen deficiency, LFL and hydrogen sulfide concentration. A written record of the pre-entry test results shall be made and kept at the work site for the duration of the job. Affected employees shall be able to review the testing results. The most hazardous conditions shall govern when work is being performed in two adjoining, connected spaces.

**Space Ventilation.** Mechanical ventilation systems, where applicable, shall be set at 100% outside air. Where possible, open additional manholes to increase air circulation. Use portable blowers to augment natural circulation if needed. After a suitable ventilating period, repeat the testing. Entry may not begin until testing has demonstrated that the hazardous atmosphere has been eliminated.

**Entry Procedures.** The following procedure shall be observed under any of the following conditions: 1.) Testing demonstrates the existence of dangerous or deficient conditions and additional ventilation cannot reduce concentrations to safe levels; 2.) The atmosphere tests as safe but unsafe conditions can reasonably be expected to develop; 3.) It is not feasible to provide for ready exit from spaces equipped with automatic fire suppression systems and it is not practical or safe to deactivate such systems; or 4.) An emergency exists and it is not feasible to wait for pre-entry procedures to take effect.

**All personnel must be trained.** A self contained breathing apparatus shall
be worn by any person entering the space. At least one worker shall stand by the outside of the space ready to give assistance in case of emergency. The standby worker shall have a self contained breathing apparatus available for immediate use. There shall be at least one additional worker within sight or call of the standby worker. Continuous powered communications shall be maintained between the worker within the confined space and standby personnel.

If at any time there is any questionable action or non-movement by the worker inside, a verbal check will be made. If there is no response, the worker will be moved immediately. **Exception:** If the worker is disabled due to falling or impact, he/she shall not be removed from the confined space unless there is immediate danger to his/her life. Local fire department rescue personnel shall be notified immediately. The standby worker may only enter the confined space in case of an emergency (wearing the self contained breathing apparatus) and only after being relieved by another worker. Safety belt or harness with attached lifeline shall be used by all workers entering the space with the free end of the line secured outside the entry opening. The standby worker shall attempt to remove a disabled worker via his lifeline before entering the space.

When practical, these spaces shall be entered through side openings -- those within 3 ½ feet (1.07 m) of the bottom. When entry must be through a top opening, the safety belt shall be of the harness type that suspends a person upright and a hoisting device or similar apparatus shall be available for lifting workers out of the space.

In any situation where their use may endanger the worker, use of a hoisting device or safety belt and attached lifeline may be discontinued.

When dangerous air contamination is attributable to flammable and/or explosive substances, lighting and electrical equipment shall be Class 1, Division 1 rated per National Electrical Code and no ignition sources shall be introduced into the area.

Continuous gas monitoring shall be performed during all confined space operations. If alarm conditions change adversely, entry personnel shall exit the confined space and a new confined space permit issued.
Rescue. Call the fire department services for rescue. Where immediate hazards to injured personnel are present, workers at the site shall implement emergency procedures to fit the situation.

EXAMPLE 2.

Workplace. Meat and poultry rendering plants.

Cookers and dryers are either batch or continuous in their operation. Multiple batch cookers are operated in parallel. When one unit of a multiple set is shut down for repairs, means are available to isolate that unit from the others which remain in operation.

Cookers and dryers are horizontal, cylindrical vessels equipped with a center, rotating shaft and agitator paddles or discs. If the inner shell is jacketed, it is usually heated with steam at pressures up to 150 psig (1034.25 kPa). The rotating shaft assembly of the continuous cooker or dryer is also steam heated.

Potential Hazards. The recognized hazards associated with cookers and dryers are the risk that employees could be:

1. Struck or caught by rotating agitator;

2. Engulfed in raw material or hot, recycled fat;

3. Burned by steam from leaks into the cooker/dryer steam jacket or the condenser duct system if steam valves are not properly closed and locked out;

4. Burned by contact with hot metal surfaces, such as the agitator shaft assembly, or inner shell of the cooker/dryer;

5. Heat stress caused by warm atmosphere inside cooker/dryer;

6. Slipping and falling on grease in the cooker/dryer;

7. Electrically shocked by faulty equipment taken into the cooker/dryer;
8. Burned or overcome by fire or products of combustion; or

9. Overcome by fumes generated by welding or cutting done on grease covered surfaces.

Permits. The supervisor in this case is always present at the cooker/dryer or other permit entry confined space when entry is made. The supervisor must follow the pre-entry isolation procedures described in the entry permit in preparing for entry, and ensure that the protective clothing, ventilating equipment and any other equipment required by the permit are at the entry site.

Control of hazards. Mechanical. Lock out main power switch to agitator motor at main power panel. Affix tag to the lock to inform others that a permit entry confined space entry is in progress.

Engulfment. Close all valves in the raw material blow line. Secure each valve in its closed position using chain and lock. Attach a tag to the valve and chain warning that a permit entry confined space entry is in progress. The same procedure shall be used for securing the fat recycle valve.

Burns and heat stress. Close steam supply valves to jacket and secure with chains and tags. Insert solid blank at flange in cooker vent line to condenser manifold duct system. Vent cooker/dryer by opening access door at discharge end and top center door to allow natural ventilation throughout the entry. If faster cooling is needed, use an portable ventilation fan to increase ventilation. Cooling water may be circulated through the jacket to reduce both outer and inner surface temperatures of cooker/dryers faster. Check air and inner surface temperatures in cooker/dryer to assure they are within acceptable limits before entering, or use proper protective clothing.

Fire and fume hazards. Careful site preparation, such as cleaning the area within 4 inches (10.16 cm) of all welding or torch cutting operations, and proper ventilation are the preferred controls. All welding and cutting operations shall be done in accordance with the requirements of 29 CFR Part 1910, Subpart Q, OSHA's welding standard. Proper ventilation may be achieved by local exhaust ventilation, or the use of portable ventilation fans, or a combination of the two practices.
**Electrical shock.** Electrical equipment used in cooker/dryers shall be in serviceable condition.

**Slides and falls.** Remove residual grease before entering cooker/dryer.

**Attendant.** The supervisor shall be the attendant for employees entering cooker/dryers.

**Permit.** The permit shall specify how isolation shall be done and any other preparations needed before making entry. This is especially important in parallel arrangements of cooker/dryers so that the entire operation need not be shut down to allow safe entry into one unit.

**Rescue.** When necessary, the attendant shall call the fire department as previously arranged.

**EXAMPLE 3.**

**Workplace.** Workplaces where tank cars, trucks, and trailers, dry bulk tanks and trailers, railroad tank cars, and similar portable tanks are fabricated or serviced.

**A. DURING FABRICATION.** These tanks and dry-bulk carriers are entered repeatedly throughout the fabrication process. These products are not configured identically, but the manufacturing processes by which they are made are very similar.

**Sources of hazards.** In addition to the mechanical hazards arising from the risks that an entrant would be injured due to contact with components of the tank or the tools being used, there is also the risk that a worker could be injured by breathing fumes from welding materials or mists or vapors from materials used to coat the tank interior. In addition, many of these vapors and mists are flammable, so the failure to properly ventilate a tank could lead to a fire or explosion.

**Control of hazards.**

**Welding.** Local exhaust ventilation shall be used to remove welding fumes once the tank or carrier is completed to the point that workers may enter and
exit only through a manhole. (Follow the requirements of 29 CFR 1910, Subpart Q, OSHA's welding standard, at all times.) Welding gas tanks may never be brought into a tank or carrier that is a permit entry confined space.

**Application of interior coatings/linings.** Atmospheric hazards shall be controlled by forced air ventilation sufficient to keep the atmospheric concentration of flammable materials below 10% of the lower flammable limit (LFL) (or lower explosive limit (LEL), whichever term is used locally). The appropriate respirators are provided and shall be used in addition to providing forced ventilation if the forced ventilation does not maintain acceptable respiratory conditions.

**Permits.** Because of the repetitive nature of the entries in these operations, an "Area Entry Permit" will be issued for a 1 month period to cover those production areas where tanks are fabricated to the point that entry and exit are made using manholes.

**Authorization.** Only the area supervisor may authorize an employee to enter a tank within the permit area. The area supervisor must determine that conditions in the tank trailer, dry bulk trailer or truck, etc. meet permit requirements before authorizing entry.

**Attendant.** The area supervisor shall designate an employee to maintain communication by employer specified means with employees working in tanks to ensure their safety. The attendant may not enter any permit entry confined space to rescue an entrant or for any other reason, unless authorized by the rescue procedure and, even then, only after calling the rescue team and being relieved by an attendant or another worker.

**Communications and observation.** Communications between attendant and entrant(s) shall be maintained throughout entry. Methods of communication that may be specified by the permit include voice, voice powered radio, tapping or rapping codes on tank walls, signaling tugs on a rope, and the attendant's observation that work activities such as chipping, grinding, welding, spraying, etc., which require deliberate operator control continue normally. These activities often generate so much noise that the necessary hearing protection makes communication by voice difficult.

**Rescue procedures.** Acceptable rescue procedures include entry by a team
of employee-rescuers, use of public emergency services, and procedures for breaching the tank. The area permit specifies which procedures are available, but the area supervisor makes the final decision based on circumstances. (Certain injuries may make it necessary to breach the tank to remove a person rather than risk additional injury by removal through an existing manhole. However, the supervisor must ensure that no breaching procedure used for rescue would violate terms of the entry permit. For instance, if the tank must be breached by cutting with a torch, the tank surfaces to be cut must be free of volatile or combustible coatings within 4 inches (10.16 cm) of the cutting line and the atmosphere within the tank must be below the LFL).

**Retrieval line and harnesses.** The retrieval lines and harnesses generally required under this standard are usually impractical for use in tanks because the internal configuration of the tanks and their interior baffles and other structures would prevent rescuers from hauling out injured entrants. However, unless the rescue procedure calls for breaching the tank for rescue, the rescue team shall be trained in the use of retrieval lines and harnesses for removing injured employees through manholes.

**B. REPAIR OR SERVICE OF “USED” TANKS AND BULK TRAILERS.**

**Sources of hazards.** In addition to facing the potential hazards encountered in fabrication or manufacturing, tanks or trailers which have been in service may contain residues of dangerous materials, whether left over from the transportation of hazardous cargoes or generated by chemical or bacterial action on residues of non-hazardous cargoes.

**Control of atmospheric hazards.** A "used" tank shall be brought into areas where tank entry is authorized only after the tank has been emptied, cleansed (without employee entry) of any residues, and purged of any potential atmospheric hazards.

**Welding.** In addition to tank cleaning for control of atmospheric hazards, coating and surface materials shall be removed 4 inches (10.16 cm) or more from any surface area where welding or other torch work will be done and care taken that the atmosphere within the tank remains well below the LFL. (Follow the requirements of 29 CFR 1910, Subpart Q, OSHA's welding standard, at all times.)
Permits. An entry permit valid for up to 1 year shall be issued prior to authorization of entry into used tank trailers, dry bulk trailers or trucks. In addition to the pre-entry cleaning requirement, this permit shall require the employee safeguards specified for new tank fabrication or construction permit areas.

Authorization. Only the area supervisor may authorize an employee to enter a tank trailer, dry bulk trailer or truck within the permit area. The area supervisor must determine that the entry permit requirements have been met before authorizing entry.

[58 FR 4549, Jan. 14, 1993; 58 FR 34846, June 29, 1993]

Standard Number: 1910.146 App D
Standard Title: Confined Space Pre-Entry Check List
SubPart Number: J
SubPart Title: General Environmental Controls

Appendix D to §§1910.146 – Confined Space Pre-Entry Check List

Appendix D-1

Confined Space Entry Permit
Date and Time Issued: _______________ Date and Time Expires: __________
Job site/Space I.D.: _______________ Job Supervisor: _______________
Equipment to be worked on: __________ Work to be performed: __________
Stand-by personnel: _______________ _______________ _______________

1. Atmospheric Checks: Time ________
   Oxygen ________ %
   Explosive ________ % L.F.L.
   Toxic ________ PPM

2. Tester's signature: _______________

3. Source isolation (No Entry): N/A Yes No
   Pumps or lines blinded, ( ) ( ) ( )
   disconnected, or blocked ( ) ( ) ( )
4. Ventilation Modification: N/A Yes No
   Mechanical ( ) ( ) ( )
   Natural Ventilation only ( ) ( ) ( )

5. Atmospheric check after isolation and Ventilation:
   Oxygen ________% > 19.5 %
   Explosive ______% L.F.L < 10 %
   Toxic _________PPM < 10 PPM H(2)S
   Time __________________
   Tester’s signature: _____________________________

6. Communication procedures: ________________________________________
   ________________________________________
   ________________________________________
   ________________________________________

7. Rescue procedures: _______________________________________________
   ________________________________________
   ________________________________________
   ________________________________________

8. Entry, standby, and back up persons: Yes No
   Successfully completed required training?
   Is it current? ( ) ( )

9. Equipment: N/A Yes No
   Direct reading gas monitor - tested ( ) ( ) ( )
   Safety harnesses and lifelines for entry and standby persons ( ) ( ) ( )
   Hoisting equipment ( ) ( ) ( )
   Powered communications ( ) ( ) ( )
   SCBA's for entry and standby persons ( ) ( ) ( )
   Protective Clothing ( ) ( ) ( )
   All electric equipment listed Class I, Division I, Group D and Non-sparking tools ( ) ( ) ( )

10. Periodic atmospheric tests:
    Oxygen ___% Time ___ Oxygen ___% Time ___
    Oxygen ___% Time ___ Oxygen ___% Time ___
    Explosive ___% Time ___ Explosive ___% Time ___
    Explosive ___% Time ___ Explosive ___% Time ___
    Toxic ___% Time ___ Toxic ___% Time ___
    Toxic ___% Time ___ Toxic ___% Time ___

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

   Permit Prepared By: (Supervisor) ________________________________________
   Approved By: (Unit Supervisor) ________________________________________
This permit to be kept at job site. Return job site copy to Safety Office following job completion.

Copies:  White Original (Safety Office)  
         Yellow (Unit Supervisor)  
         Hard (Job site)

Appendix D - 2

ENTRY PERMIT

PERMIT VALID FOR 8 HOURS ONLY. ALL COPIES OF PERMIT WILL REMAIN AT JOB SITE UNTIL JOB IS COMPLETED

DATE: - -  SITE LOCATION and DESCRIPTION ________________________________
PURPOSE OF ENTRY ______________________________________________________
SUPERVISOR(S) in charge of crews   Type of Crew Phone #

______________________________________________________________  
COMMUNICATION PROCEDURES  
RESCUE PROCEDURES (PHONE NUMBERS AT BOTTOM) ___________________________  

* BOLD DENOTES MINIMUM REQUIREMENTS TO BE COMPLETED AND REVIEWED PRIOR TO ENTRY*

<table>
<thead>
<tr>
<th>REQUIREMENTS COMPLETED</th>
<th>DATE</th>
<th>TIME</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lock Out/De-energize/Try-out</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Line(s) Broken-Capped-Blanked</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Purge-Flush and Vent</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ventilation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Secure Area (Post and Flag)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Breathing Apparatus</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Resuscitator - Inhalator</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Standby Safety Personnel</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Full Body Harness w/&quot;D&quot; ring</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Emergency Escape Retrieval Equip</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lifelines</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Fire Extinguishers</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lighting (Explosive Proof)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Protective Clothing</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Respirator(s) (Air Purifying)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Burning and Welding Permit</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Note: Items that do not apply enter N/A in the blank.

**RECORD CONTINUOUS MONITORING RESULTS EVERY 2 HOURS**

<table>
<thead>
<tr>
<th>TESTS TO BE TAKEN **</th>
<th>PERCENT OF OXYGEN</th>
<th>LOWER FLAMMABLE LIMIT</th>
<th>CARBON MONOXIDE</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Permissible</strong></td>
<td>19.5% to 23.5%</td>
<td>Under 10%</td>
<td>+35 PPM</td>
</tr>
</tbody>
</table>
Aromatic Hydrocarbon  + 1 PPM * 5PPM ___ ___ ___ ___ ___ ___ ___ ___
Hydrogen Cyanide (Skin) * 4PPM ___ ___ ___ ___ ___ ___ ___ ___
Hydrogen Sulfide + 10 PPM *15PPM ___ ___ ___ ___ ___ ___ ___ ___
Sulfur Dioxide + 2 PPM * 5PPM ___ ___ ___ ___ ___ ___ ___ ___
Ammonia *35PPM ___ ___ ___ ___ ___ ___ ___ ___

* Short-term exposure limit: Employee can work in the area up to 15 minutes.
+ 8 hr. Time Weighted Avg.: Employee can work in area 8 hrs (longer with appropriate respiratory protection).

REMARKS:_____________________________________________________________

GAS TESTER NAME INSTRUMENT(S) MODEL SERIAL &/OR CHECK # USED &/OR TYPE UNIT #
________________     _______________    ___________      ____________
________________     _______________    ___________      ____________

SAFETY STANDBY PERSON IS REQUIRED FOR ALL CONFINED SPACE WORK

SAFETY STANDBY CHECK # CONFINED CONFINED
PERSON(S) SPACE CHECK # SPACE CHECK #
________________     _______    __________  _______   __________   _______
________________     _______    __________  _______   __________   _______

SUPERVISOR AUTHORIZING - ALL CONDITIONS SATISFIED

DEPARTMENT/PHONE
AMBULANCE 2800 FIRE 2900 Safety 4901 Gas Coordinator 4529/5387

[58 FR 4549, Jan. 14, 1993; 58 FR 34846, June 29, 1993]
Appendix E to §§1910.146
Sewer System Entry

Sewer entry differs in three vital respects from other permit entries; first, there rarely exists any way to completely isolate the space (a section of a continuous system) to be entered; second, because isolation is not complete, the atmosphere may suddenly and unpredictably become lethally hazardous (toxic, flammable or explosive) from causes beyond the control of the entrant or employer, and third, experienced sewer workers are especially knowledgeable in entry and work in their permit spaces because of their frequent entries. Unlike other employments where permit space entry is a rare and exceptional event, sewer workers' usual work environment is a permit space.

(1) Adherence to procedure. The employer should designate as entrants only employees who are thoroughly trained in the employer's sewer entry procedures and who demonstrate that they follow these entry procedures exactly as prescribed when performing sewer entries.

(2) Atmospheric monitoring. Entrants should be trained in the use of, and be equipped with, atmospheric monitoring equipment which sounds an audible alarm, in addition to its visual readout, whenever one of the following conditions are encountered: Oxygen concentration less than 19.5 percent; flammable gas or vapor at 10 percent or more of the lower flammable limit (LFL); or hydrogen sulfide or carbon monoxide at or above 10 ppm or 35 ppm, respectively, measured as an 8-hour time-weighted average. Atmospheric monitoring equipment needs to be calibrated according to the manufacturer's instructions. The oxygen sensor/broad range sensor is best suited for initial use in situations where the actual or potential contaminants have not been identified, because broad range sensors, unlike substance-specific sensors, enable employers to obtain an overall reading of the hydrocarbons (flammables) present in the space. However, such sensors only indicate that a hazardous threshold of a class of chemicals has been exceeded. They do not measure the levels of contamination of specific substances. Therefore, substance-specific devices, which measure the actual levels of specific substances, are best suited for use where actual and potential contaminants have been identified. The measurements obtained with substance-specific devices are of vital importance to the employer when decisions are made concerning the measures necessary to protect entrants (such as ventilation or personal protective equipment) and the setting and attainment of
appropriate entry conditions. However, the sewer environment may suddenly and unpredictably change, and the substance-specific devices may not detect the potentially lethal atmospheric hazards which may enter the sewer environment.

Although OSHA considers the information and guidance provided above to be appropriate and useful in most sewer entry situations, the Agency emphasizes that each employer must consider the unique circumstances, including the predictability of the atmosphere, of the sewer permit spaces in the employer's workplace in preparing for entry. Only the employer can decide, based upon his or her knowledge of, and experience with permit spaces in sewer systems, what the best type of testing instrument may be for any specific entry operation.

The selected testing instrument should be carried and used by the entrant in sewer line work to monitor the atmosphere in the entrant's environment, and in advance of the entrant's direction of movement, to warn the entrant of any deterioration in atmospheric conditions. Where several entrants are working together in the same immediate location, one instrument, used by the lead entrant, is acceptable.

(3) Surge flow and flooding. Sewer crews should develop and maintain liaison, to the extent possible, with the local weather bureau and fire and emergency services in their area so that sewer work may be delayed or interrupted and entrants withdrawn whenever sewer lines might be suddenly flooded by rain or fire suppression activities, or whenever flammable or other hazardous materials are released into sewers during emergencies by industrial or transportation accidents.

(4) Special Equipment. Entry into large bore sewers may require the use of special equipment. Such equipment might include such items as atmosphere monitoring devices with automatic audible alarms, escape self-contained breathing apparatus (ESCBA) with at least 10 minute air supply (or other NIOSH approved self-rescuer), and waterproof flashlights, and may also include boats and rafts, radios and rope stand-offs for pulling around bends and corners as needed.

Non-Mandatory Appendix F -- Rescue Team
or Rescue Service Evaluation Criteria

(1) This appendix provides guidance to employers in choosing an appropriate rescue service. It contains criteria that may be used to evaluate the capabilities both of prospective and current rescue teams. Before a rescue team can be trained or chosen, however, a satisfactory permit program, including an analysis of all permit-required confined spaces to identify all potential hazards in those spaces, must be completed. OSHA believes that compliance with all the provisions of §§1910.146 will enable employers to conduct permit space operations without recourse to rescue services in nearly all cases. However, experience indicates that circumstances will arise where entrants will need to be rescued from permit spaces. It is therefore important for employers to select rescue services or teams, either on-site or off-site, that are equipped and capable of minimizing harm to both entrants and rescuers if the need arises.

(2) For all rescue teams or services, the employer’s evaluation should consist of two components: an initial evaluation, in which employers decide whether a potential rescue service or team is adequately trained and equipped to perform permit space rescues of the kind needed at the facility and whether such rescuers can respond in a timely manner, and a performance evaluation, in which employers measure the performance of the team or service during an actual or practice rescue. For example, based on the initial evaluation, an employer may determine that maintaining an on-site rescue team will be more expensive than obtaining the services of an off-site team,
without being significantly more effective, and decide to hire a rescue service. During a performance evaluation, the employer could decide, after observing the rescue service perform a practice rescue, that the service's training or preparedness was not adequate to effect a timely or effective rescue at his or her facility and decide to select another rescue service, or to form an internal rescue team.

**A. Initial Evaluation**

**I.** The employer should meet with the prospective rescue service to facilitate the evaluations required by §§1910.146(k)(1)(i) and §§1910.146(k)(1)(ii). At a minimum, if an off-site rescue service is being considered, the employer must contact the service to plan and coordinate the evaluations required by the standard. Merely posting the service’s number or planning to rely on the 911 emergency phone number to obtain these services at the time of a permit space emergency would not comply with paragraph (k)(1) of the standard.

**II.** The capabilities required of a rescue service vary with the type of permit spaces from which rescue may be necessary and the hazards likely to be encountered in those spaces. Answering the questions below will assist employers in determining whether the rescue service is capable of performing rescues in the permit spaces present at the employer's workplace.

1. **What are the needs of the employer with regard to response time (time for the rescue service to receive notification, arrive at the scene, and set up and be ready for entry)?** For example, if entry is to be made into an IDLH atmosphere, or into a space that can quickly develop an IDLH atmosphere (if ventilation fails or for other reasons), the rescue team or service would need to be standing by at the permit space. On the other hand, if the danger to entrants is restricted to mechanical hazards that would cause injuries (e.g., broken bones, abrasions) a response time of 10 or 15 minutes might be adequate.

2. **How quickly can the rescue team or service get from its location to the permit spaces from which rescue may be necessary?** Relevant factors to consider would include: the location of the rescue team or service relative to the employer's workplace, the quality of roads and highways to be traveled, potential bottlenecks or traffic congestion that might be encountered in transit, the reliability of the rescuer's vehicles,
and the training and skill of its drivers.

3. What is the availability of the rescue service? Is it unavailable at certain times of the day or in certain situations? What is the likelihood that key personnel of the rescue service might be unavailable at times? If the rescue service becomes unavailable while an entry is underway, does it have the capability of notifying the employer so that the employer can instruct the attendant to abort the entry immediately?

4. Does the rescue service meet all the requirements of paragraph (k)(2) of the standard? If not, has it developed a plan that will enable it to meet those requirements in the future? If so, how soon can the plan be implemented?

5. For off-site services, is the service willing to perform rescues at the employer's workplace? (An employer may not rely on a rescuer who declines, for whatever reason, to provide rescue services.)

6. Is an adequate method for communications between the attendant, employer and prospective rescuer available so that a rescue request can be transmitted to the rescuer without delay? How soon after notification can a prospective rescuer dispatch a rescue team to the entry site?

7. For rescues into spaces that may pose significant atmospheric hazards and from which rescue entry, patient packaging and retrieval cannot be safely accomplished in a relatively short time (15-20 minutes), employers should consider using airline respirators (with escape bottles) for the rescuers and to supply rescue air to the patient. If the employer decides to use SCBA, does the prospective rescue service have an ample supply of replacement cylinders and procedures for rescuers to enter and exit (or be retrieved) well within the SCBA's air supply limits?

8. If the space has a vertical entry over 5 feet in depth, can the prospective rescue service properly perform entry rescues? Does the service have the technical knowledge and equipment to perform rope work or elevated rescue, if needed?
9. Does the rescue service have the necessary skills in medical evaluation, patient packaging and emergency response?

10. Does the rescue service have the necessary equipment to perform rescues, or must the equipment be provided by the employer or another source?

**B. Performance Evaluation**

Rescue services are required by paragraph (k)(2)(iv) of the standard to practice rescues at least once every 12 months, provided that the team or service has not successfully performed a permit space rescue within that time. As part of each practice session, the service should perform a critique of the practice rescue, or have another qualified party perform the critique, so that deficiencies in procedures, equipment, training, or number of personnel can be identified and corrected. The results of the critique, and the corrections made to respond to the deficiencies identified, should be given to the employer to enable it to determine whether the rescue service can quickly be upgraded to meet the employer's rescue needs or whether another service must be selected. The following questions will assist employers and rescue teams and services evaluate their performance.

1. Have all members of the service been trained as permit space entrants, at a minimum, including training in the potential hazards of all permit spaces, or of representative permit spaces, from which rescue may be needed? Can team members recognize the signs, symptoms, and consequences of exposure to any hazardous atmospheres that may be present in those permit spaces?

2. Is every team member provided with, and properly trained in, the use and need for PPE, such as SCBA or fall arrest equipment, which may be required to perform permit space rescues in the facility? Is every team member properly trained to perform his or her functions and make rescues, and to use any rescue equipment, such as ropes and backboards, that may be needed in a rescue attempt?

3. Are team members trained in the first aid and medical skills needed to treat victims overcome or injured by the types of hazards that may be encountered in the permit spaces at the facility?
4. Do all team members perform their functions safely and efficiently? Do rescue service personnel focus on their own safety before considering the safety of the victim?

5. If necessary, can the rescue service properly test the atmosphere to determine if it is IDLH?

6. Can the rescue personnel identify information pertinent to the rescue from entry permits, hot work permits, and MSDSs?

7. Has the rescue service been informed of any hazards to personnel that may arise from outside the space, such as those that may be caused by future work near the space?

8. If necessary, can the rescue service properly package and retrieve victims from a permit space that has a limited size opening (less than 24 inches (60.9 cm) in diameter), limited internal space, or internal obstacles or hazards?

9. If necessary, can the rescue service safely perform an elevated (high angle) rescue?

10. Does the rescue service have a plan for each of the kinds of permit space rescue operations at the facility? Is the plan adequate for all types of rescue operations that may be needed at the facility? Teams may practice in representative spaces, or in spaces that are "worst-case" or most restrictive with respect to internal configuration, elevation, and portal size. The following characteristics of a practice space should be considered when deciding whether a space is truly representative of an actual permit space:

   (1) INTERNAL CONFIGURATION.

   (a) Open -- there are no obstacles, barriers, or obstructions within the space. One example is a water tank.

   (b) Obstructed -- the permit space contains some type of
obstruction that a rescuer would need to maneuver around. An example would be a baffle or mixing blade. Large equipment, such as a ladder or scaffold, brought into a space for work purposes would be considered an obstruction if the positioning or size of the equipment would make rescue more difficult.

(2) ELEVATION.

(a) Elevated -- a permit space where the entrance portal or opening is above grade by 4 feet or more. This type of space usually requires knowledge of high angle rescue procedures because of the difficulty in packaging and transporting a patient to the ground from the portal.

(b) Non-elevated -- a permit space with the entrance portal located less than 4 feet above grade. This type of space will allow the rescue team to transport an injured employee normally.

(3) PORTAL SIZE.

(a) Restricted -- A portal of 24 inches or less in the least dimension. Portals of this size are too small to allow a rescuer to simply enter the space while using SCBA. The portal size is also too small to allow normal spinal immobilization of an injured employee.

(b) Unrestricted -- A portal of greater than 24 inches in the least dimension. These portals allow relatively free movement into and out of the permit space.

(4) SPACE ACCESS.

(a) Horizontal -- The portal is located on the side of the permit space. Use of retrieval lines could be difficult.

(b) Vertical -- The portal is located on the top of the permit space, so that rescuers must climb down, or the bottom of the permit space, so that rescuers must climb up to enter the space. Vertical portals may require knowledge of rope techniques, or
special patient packaging to safely retrieve a downed entrant.

[63 FR 66039, Dec. 1, 1998]

Selected Examples of
OSHA Letters of Interpretation:
Permit-required confined spaces - 1910.146

Record Type: Interpretation
Standard Number: 1910.146(b)
Subject: PRCS entry: the term "body" includes all extremities.
Information Date: 10/20/1999

Michael Johnson
Oxy Vinyls, LP
Louisville Plant
Bells Lane, P.O. Box 34370
Louisville, KY 40232-4370

Dear Mr. Johnson:

Thank you for your September 28, 1999 letter to the Occupational Safety and Health Administration’s (OSHA’s) Office of General Industry Compliance Assistance (GICA). You have a question regarding the Permit-Required Confined Spaces standard, 29 CFR 1910.146. Your question is restated below for clarity.

Question. In terms of permit-required confined space entry, does "body" include all extremities (hands, feet, arms and legs) or does it indicate just the head and torso?

Reply. The term "body" refers to any part of the anatomy including all extremities.
Thank you for your interest in occupational safety and health. We hope you find this information helpful. Please be aware that OSHA’s enforcement guidance is subject to periodic review and clarification, amplification, or correction. Such guidance could also be affected by subsequent rule-making. In the future, should you wish to verify that the guidance provided herein remains current, you may consult OSHA’s website at http://www.osha.gov. If you have any further questions, please feel free to contact the Office of General Industry Compliance Assistance at (202) 693-1850.

Sincerely,

Richard E. Fairfax, Director
Directorate of Compliance Programs

Record Type: Interpretation
Standard Number: 1910.146
Subject: Electronic monitoring system for complying with the confined space standard.
Information Date: 11/13/1997

November 13, 1997

Robert R. Lynch
OCAW Local 4-23
1500 Jefferson Drive
Port Arthur, TX 77642

Dear Mr. Lynch:

This letter is in response to your letter to Ray Skinner regarding the suitability of an electronic monitoring system for complying with the confined space standard (29 CFR 1910.146). Your letter was forwarded to the national office for a response.
The use of an electronic monitoring system is permitted by the standard. It is not intended to completely replace attendants, but to serve as an aid in the monitoring process. Its use does not automatically violate the standard, nor does it mean the employer is automatically in compliance with the standard. It is really a matter of how the device is used. Properly used, it can effectively increase the number of permit spaces a single attendant is able to effectively and simultaneously monitor. The use of such equipment can actually perform some of the attendant’s duties better than the common practice of just having an attendant outside the space. Other duties, on the other hand, may need additional attendants to be properly satisfied.

All the duties described in paragraph (i) of the standard must be effectively performed for each permit space being monitored. Each confined space must be evaluated by the employer to determine the hazards that could exist for the entrant. If the space cannot be adequately attended by using a remote attendant, then added precautions or procedures must be taken to protect the entrant. Some situations may require another person or additional equipment to perform one or more of the attendants duties. The Product Bulletin you sent us addresses several of the limitations a single attendant may face when monitoring more than one space.

Proper training of the attendant becomes even more critical with the use of such a system. The attendant must be totally familiar with the use of the system and indicators or alarms that may alert him of a problem in the confined spaces. When such a device is used in a confined space program, its use and limitations must also be included in the training of the entrant and entry supervisors and the program modified to cover how any limitations will be addressed. Its effectiveness should also be included in the periodic evaluation of the program.

If you have any further questions, please contact Craig Moulton of my staff. Thank you for your interests in safety and health.

Sincerely,

John B. Miles, Jr.
December 10, 1996

Mr. Michael L. Coleman
Neotronics of North America
P.O. Box 2100
Flowery Branch, GA 30542-2100

Dear Mr. Coleman:

This is in response to your request of September 16, addressed to Occupational Safety and Health Administration's (OSHA's) Deputy Regional Administrator for Region IV requesting an interpretation of 29 CFR 1910.146 concerning the recording of atmospheric test results. Your inquiry was forwarded to my office for response.

We have repeated your questions to aid other readers with the responses.

**Question:** Please define OSHA's expectation with regard to maintaining written (or stored) data relative to areas to be entered and the real time, Single Time Exposure Limits (STEL), Time Weighted Averages (TWA) values of atmospheres therein?

**Answer:** The Permit-Required Confined Spaces (PRCS) standard, as a generic procedural standard for work activities in permit spaces, does not address terms such as STEL and TWA. These terms related to employee health monitoring addressed by other OSHA standards.

**Note:** Real time, for the purposes of this response, is that time during the testing process when the direct reading instrument is viewed for the value of the substance being tested.
Regarding data OSHA expects to be maintained from the PRCS standard's position:

1. Paragraph (f)(10) requires the results of initial and periodic tests required by paragraph (d)(5) be recorded on the entry permit and maintained for 1 year. OSHA has made a determination regarding sampling results obtained through testing PRCS atmospheres. It is enclosed for your information.

2. Paragraph (c)(5)(i)(C) requires that the data resulting from monitoring and inspections demonstrate that the continuous forced air ventilation is maintaining the permit space safe for entry. As a performance standard, however, there is no minimum or maximum number of data entries. The preamble (Pg. 4488) of the final rule sheds light as to the quantity of data issue. It states . . . "The data required by paragraph (c)(5)(i)(C) are essential for the employer and employees, as well as OSHA, to be able to determine whether or not the space is being maintained safe for entry with the use of ventilation alone." Thus, from a compliance position, the quantity of data being maintained must be sufficient to convince OSHA that the powered ventilation equipment and the way the fresh air is being distributed to the immediate area where the employees are or will be working is functioning properly.

The values to be recorded on the entry permit or recorded when the atmospheric concentration needs to be documented by the standard are "real time" concentrations.

**Question:** Is a user required to document actual numeric values of all three atmospheres (Real Time, STEL, and TWA) at any time?
**Answer:** No, from a 29 CFR 1910.146 prospective, the only values to be documented (recorded) are real time values.

**Question:** Does the expectation include written documents on the atmosphere in real time real value sense prior to entry as suggested in appendix B to 1910.146 - Procedures for Atmospheric Testing Item (2) Verification testing?

**Answer:** Yes. The standard requires that employers record initial and periodic test results on the entry permit.

**Question:** If a gas detector reads only real time values (and does no
calculations for averaging STEL or TWA), in what way are alarm set-points impacted?

**Answer:** The PRCS standard does not require alarm set-points for testing instruments.

Regarding further assistance requested, usually the answers to questions such as these (OSHA's intent and meaning of standards) can be found either on a CD-ROM titled *OSHA Regulations, Documents, and Technical Information on CD-ROM* available through the Government Printing Office or OSHA's Internet server in Salt Lake City (http://www.osha-slc.gov/). Attached is information on these two sources.

If you have further questions on this response, please contact Mr. Don Kallstrom in the Office of Safety Compliance Assistance at 202 219-8031 x 109. For other questions regarding this or another OSHA standard or regulation, please continue to work directly with OSHA's Regional staff.

Sincerely,

John B. Miles, Jr., Director
Directorate of Compliance Programs

---

**Record Type:** Interpretation  
**Standard Number:** 1910.134; 1910.146  
**Subject:** Entry into a confined space when the lower flammable limit is greater than ten percent.  
**Information Date:** 09/04/1996
September 4, 1996

Mr. Macon Jones  
Blasting Cleaning Products LTD.  
2180 Speers Road  
Oakville, Ontario  
Canada L6L2X8

Dear Mr. Jones:

This is response to your request of April 10, requesting clarification of the 29 CFR 1910.146 standard. Please accept our apology for the delay. Responses to your questions follow:

**Question 1.** If an enclosed space is a "permit required confined space" (PRCS) and all of the proper procedures are implemented, can entry be made and work performed (or continued) if the measured lower flammable limit (LFL) is greater than 10%?

**Answer:** Yes. The permit-required confined spaces standard (29 CFR 1910.146) does not prohibit working in a permit-required space where the atmosphere is above 10% of the LFL. Once the atmosphere is above 10% of the LFL, all of the requirements of the standard must be met.

**Question 2.** Regarding the above question (question 1) are there particular procedures or precautions that are required under these conditions?

**Answer:** Since PRCS is a performance standard, it does not specify procedures for conditions where the permit-required space has a hazardous flammable atmosphere. However, what the standard does specify in paragraph (d) is that the employer must identify and evaluate each hazard to which the entering employees will be exposed. Based on the hazard analysis, the employer must develop and implement the means, procedures, and practices necessary for safe permit space entry operations.

Although the PRCS standard may not specify or necessarily apply to specific precautions an employer must take regarding a hazardous flammable atmosphere, other OSHA standards could apply. For example, if the
flammable atmosphere also presented a respiratory hazard requiring protection, 29 CFR 1910.134 specifies precautions relative to the selection and use of respirators. If the flammable atmosphere is the result of a process involving equipment, there may be precautions with regard to the equipment that an employer could be required to follow.

**Question 3.** Have OSHA or any other government agencies made specific studies regarding the difficulties of accurately calibrating (LFL) monitoring devices, when multiple solvent coatings are used in a spray coating?

**Answer:** OSHA is not aware of any specific studies that have been conducted in this area. However, we understand that most manufacturers of this type of testing equipment have addressed this issue. Manufacturers setup and calibrate their equipment using a single calibration gas (usually methane) and then provide their end users with conversion tables or factors for determining the percentage of the LFL for other gases. Where the finish being applied is a mixture, the manufacturer of the coating, through the Material Safety Data Sheet or other product information, is able to advise the employer of the individual solvent characteristics.

**Question 4.** Have OSHA or any other government agencies made specific studies as to minimum and maximum distances LFL monitoring equipment may be located from the spray process, without adversely affecting worker safety? (Or adversely affecting monitoring equipment reliability?) Where can copies of these study results be obtained?

Per your conversation with Don Kallstrom of my staff, the root question is, Where and how often is monitoring required under 29 CFR 1910.146(d)(5)(ii) to meet the intent of the standard for a spray painting operation within a railroad tank car?

**Answer:** The standard does not specify frequency rates because of the performance oriented nature of the standard and the unique hazards of each space. However, there will always be, to some degree, testing or monitoring during the entry operations which is reflective of the atmospheric hazard.

The employer must determine the degree and the frequency of testing or monitoring. Some of the factors that affect frequency are results of test allowing entry, the regularity of entry (daily, weekly, or monthly), the uniformity
of the permit space (the extent to which the configuration, use, and contents vary), the documented history of previous monitoring activities, and knowledge of the hazards which affect the permit space as well as the historical experience gained from monitoring results of previous entries.

Knowledge and recorded data gained from successive entries (such as ventilation required to maintain acceptable entry conditions) may also be used to document changes in the frequency of monitoring.

The placement of the testing or monitoring instrument in relation to the employee performing spray coating operations is also not specified in the standard. The intent of this paragraph is to ensure that the predetermined acceptable entry conditions established by the employer are being maintained during the entry. Where the employer can demonstrate that the hazard concentration to which the employee is being exposed is uniform throughout the tank car being sprayed, then the placement of the instrument is not critical.

Should you have further questions on this correspondence please contact Mr. Don Kallstrom of my Office of Safety Compliance Assistance staff (202)219-8031 x 109.

John B. Miles, Jr., Director
Directorate of Compliance Programs
OSHA Regulations (Standards - 29 CFR)
The Control of Hazardous Energy
(lockout/tagout) - 1910.147*

(a)
Scope, application and purpose -

(a)(1)
Scope

(a)(1)(i)
This standard covers the servicing and maintenance of machines and equipment in which the unexpected energization or start up of the machines or equipment, or release of stored energy could cause injury to employees. This standard establishes minimum performance requirements for the control of such hazardous energy.

(a)(1)(ii)
This standard does not cover the following:

(a)(1)(ii)(A)
Construction, agriculture and maritime employment;

(a)(1)(ii)(B)
Installations under the exclusive control of electric utilities for the purpose of power generation, transmission and distribution, including related equipment for communication or metering; and

*Downloaded from www.osha.gov on 8/25/00. Bold type has been added to paragraph headings and other paragraphs cited in this regulation.
(a)(1)(ii)(C) Exposure to electrical hazards from work on, near, or with conductors or equipment in electric utilization installations, which is covered by Subpart S of this part; and

(a)(1)(ii)(D) Oil and gas well drilling and servicing.

(a)(2) Application.

(a)(2)(i) This standard applies to the control of energy during servicing and/or maintenance of machines and equipment.

(a)(2)(ii) Normal production operations are not covered by this standard (See Subpart O of this Part). Servicing and/or maintenance which takes place during normal production operations is covered by this standard only if:

(a)(2)(ii)(A) An employee is required to remove or bypass a guard or other safety device; or

(a)(2)(ii)(B) An employee is required to place any part of his or her body into an area on a machine or piece of equipment where work is actually performed upon the material being processed (point of operation) or where an associated danger zone exists during a machine operating cycle.

**Note:** Exception to paragraph (a)(2)(ii): Minor tool changes and adjustments, and other minor servicing activities, which take place during normal production operations, are not covered by this standard if they are routine, repetitive, and integral to the use of the equipment for production, provided that the work is performed using alternative measures which provide effective protection (See Subpart O of this Part).
(a)(2)(iii)
This standard does not apply to the following:

(a)(2)(iii)(A)
Work on cord and plug connected electric equipment for which exposure to the hazards of unexpected energization or start up of the equipment is controlled by the unplugging of the equipment from the energy source and by the plug being under the exclusive control of the employee performing the servicing or maintenance.

(a)(2)(iii)(B)
Hot tap operations involving transmission and distribution systems for substances such as gas, steam, water or petroleum products when they are performed on pressurized pipelines, provided that the employer demonstrates that-

(a)(2)(iii)(B)(1)
continuity of service is essential;

(a)(2)(iii)(B)(2)
shutdown of the system is impractical; and

(a)(2)(iii)(B)(3)
documented procedures are followed, and special equipment is used which will provide proven effective protection for employees.

(a)(3)
Purpose.

(a)(3)(i)
This section requires employers to establish a program and utilize procedures for affixing appropriate lockout devices or tagout devices to energy isolating devices, and to otherwise disable machines or equipment to prevent unexpected energization, start up or release of stored energy in order to prevent injury to employees.
(a)(3)(ii) When other standards in this part require the use of lockout or tagout, they shall be used and supplemented by the procedural and training requirements of this section.

(b) Definitions applicable to this section.

Affected employee. An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.

Authorized employee. A person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment. An affected employee becomes an authorized employee when that employee’s duties include performing servicing or maintenance covered under this section.

Capable of being locked out. An energy isolating device is capable of being locked out if it has a hasp or other means of attachment to which, or through which, a lock can be affixed, or it has a locking mechanism built into it. Other energy isolating devices are capable of being locked out, if lockout can be achieved without the need to dismantle, rebuild, or replace the energy isolating device or permanently alter its energy control capability.

Energized. Connected to an energy source or containing residual or stored energy.

Energy isolating device. A mechanical device that physically prevents the transmission or release of energy, including but not limited to the following: A manually operated electrical circuit breaker; a disconnect switch; a manually operated switch by which the conductors of a circuit can be disconnected from all ungrounded supply conductors, and, in addition, no pole can be operated independently; a line valve; a block; and any similar device used to block or isolate energy. Push buttons, selector switches and other control circuit type devices are not energy isolating devices.
**Energy source.** Any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

**Hot tap.** A procedure used in the repair, maintenance and services activities which involves welding on a piece of equipment (pipelines, vessels or tanks) under pressure, in order to install connections or appurtenances. It is commonly used to replace or add sections of pipeline without the interruption of service for air, gas, water, steam, and petrochemical distribution systems.

**Lockout.** The placement of a lockout device on an energy isolating device, in accordance with an established procedure, ensuring that the energy isolating device and the equipment being controlled cannot be operated until the lockout device is removed.

**Lockout device.** A device that utilizes a positive means such as a lock, either key or combination type, to hold an energy isolating device in the safe position and prevent the energizing of a machine or equipment. Included are blank flanges and bolted slip blinds.

**Normal production operations.** The utilization of a machine or equipment to perform its intended production function.

**Servicing and/or maintenance.** Workplace activities such as constructing, installing, setting up, adjusting, inspecting, modifying, and maintaining and/or servicing machines or equipment. These activities include lubrication, cleaning or unjamming of machines or equipment and making adjustments or tool changes, where the employee may be exposed to the unexpected energization or startup of the equipment or release of hazardous energy.

**Setting up.** Any work performed to prepare a machine or equipment to perform its normal production operation.

**Tagout.** The placement of a tagout device on an energy isolating device, in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.
Tagout device. A prominent warning device, such as a tag and a means of attachment, which can be securely fastened to an energy isolating device in accordance with an established procedure, to indicate that the energy isolating device and the equipment being controlled may not be operated until the tagout device is removed.

(c)
General -

(c)(1)
Energy control program. The employer shall establish a program consisting of energy control procedures, employee training and periodic inspections to ensure that before any employee performs any servicing or maintenance on a machine or equipment where the unexpected energizing, startup or release of stored energy could occur and cause injury, the machine or equipment shall be isolated from the energy source and rendered inoperative.

(c)(2)
Lockout/tagout.

(c)(2)(i)
If an energy isolating device is not capable of being locked out, the employer's energy control program under paragraph (c)(1) of this section shall utilize a tagout system.

(c)(2)(ii)
If an energy isolating device is capable of being locked out, the employer's energy control program under paragraph (c)(1) of this section shall utilize lockout, unless the employer can demonstrate that the utilization of a tagout system will provide full employee protection as set forth in paragraph (c)(3) of this section.

(c)(2)(iii)
After January 2, 1990, whenever replacement or major repair, renovation or modification of a machine or equipment is performed, and whenever new machines or equipment are installed, energy isolating devices for such
machine or equipment shall be designed to accept a lockout device.

(c)(3)  
**Full employee protection.**

(c)(3)(i)  
When a tagout device is used on an energy isolating device which is capable of being locked out, the tagout device shall be attached at the same location that the lockout device would have been attached, and the employer shall demonstrate that the tagout program will provide a level of safety equivalent to that obtained by using a lockout program.

(c)(3)(ii)  
In demonstrating that a level of safety is achieved in the tagout program which is equivalent to the level of safety obtained by using a lockout program, the employer shall demonstrate full compliance with all tagout-related provisions of this standard together with such additional elements as are necessary to provide the equivalent safety available from the use of a lockout device. Additional means to be considered as part of the demonstration of full employee protection shall include the implementation of additional safety measures such as the removal of an isolating circuit element, blocking of a controlling switch, opening of an extra disconnecting device, or the removal of a valve handle to reduce the likelihood of inadvertent energization.

(c)(4)  
**Energy control procedure.**

(c)(4)(i)  
Procedures shall be developed, documented and utilized for the control of potentially hazardous energy when employees are engaged in the activities covered by this section.

**Note:** Exception: The employer need not document the required procedure for a particular machine or equipment, when all of the following elements exist: (1) The machine or equipment has no potential for stored or residual energy or reaccumulation of stored...
energy after shut down which could endanger employees; (2) the machine or equipment has a single energy source which can be readily identified and isolated; (3) the isolation and locking out of that energy source will completely deenergize and deactivate the machine or equipment; (4) the machine or equipment is isolated from that energy source and locked out during servicing or maintenance; (5) a single lockout device will achieve a locker-out condition; (6) the lockout device is under the exclusive control of the authorized employee performing the servicing or maintenance; (7) the servicing or maintenance does not create hazards for other employees; and (8) the employer, in utilizing this exception, has had no accidents involving the unexpected activation or reenergization of the machine or equipment during servicing or maintenance.

(c)(4)(ii)
The procedures shall clearly and specifically outline the scope, purpose, authorization, rules, and techniques to be utilized for the control of hazardous energy, and the means to enforce compliance including, but not limited to, the following:

(c)(4)(ii)(A) A specific statement of the intended use of the procedure;

(c)(4)(ii)(B) Specific procedural steps for shutting down, isolating, blocking and securing machines or equipment to control hazardous energy;

(c)(4)(ii)(C) Specific procedural steps for the placement, removal and transfer of lockout devices or tagout devices and the responsibility for them; and

(c)(4)(ii)(D) Specific requirements for testing a machine or equipment to determine and verify the effectiveness of lockout devices, tagout devices, and other energy control measures.

(c)(5)
Protective materials and hardware.

(c)(5)(i)
Locks, tags, chains, wedges, key blocks, adapter pins, self-locking fasteners, or other hardware shall be provided by the employer for isolating, securing or blocking of machines or equipment from energy sources.

(c)(5)(ii)
Lockout devices and tagout devices shall be singularly identified; shall be the only devices(s) used for controlling energy; shall not be used for other purposes; and shall meet the following requirements:

(c)(5)(ii)(A)
Durable.

(c)(5)(ii)(A)(1)
Lockout and tagout devices shall be capable of withstanding the environment to which they are exposed for the maximum period of time that exposure is expected.

(c)(5)(ii)(A)(2)
Tagout devices shall be constructed and printed so that exposure to weather conditions or wet and damp locations will not cause the tag to deteriorate or the message on the tag to become illegible.

(c)(5)(ii)(A)(3)
Tags shall not deteriorate when used in corrosive environments such as areas where acid and alkali chemicals are handled and stored.

(c)(5)(ii)(B)
Standardized. Lockout and tagout devices shall be standardized within the facility in at least one of the following criteria: Color; shape; or size; and additionally, in the case of tagout devices, print and format shall be standardized.

(c)(5)(ii)(C)
Substantial -
(c)(5)(ii)(C)(1) **Lockout devices.** Lockout devices shall be substantial enough to prevent removal without the use of excessive force or unusual techniques, such as with the use of bolt cutters or other metal cutting tools.

(c)(5)(ii)(C)(2) **Tagout devices.** Tagout devices, including their means of attachment, shall be substantial enough to prevent inadvertent or accidental removal. Tagout device attachment means shall be of a non-reusable type, attachable by hand, self-locking, and non-releasable with a minimum unlocking strength of no less than 50 pounds and having the general design and basic characteristics of being at least equivalent to a one-piece, all environment-tolerant nylon cable tie.

(c)(5)(ii)(D) Identifiable. Lockout devices and tagout devices shall indicate the identity of the employee applying the device(s).

(c)(5)(iii) Tagout devices shall warn against hazardous conditions if the machine or equipment is energized and shall include a legend such as the following: **Do Not Start. Do Not Open. Do Not Close. Do Not Energize. Do Not Operate.**

(c)(6) **Periodic inspection.**

(c)(6)(i) The employer shall conduct a periodic inspection of the energy control procedure at least annually to ensure that the procedure and the requirements of this standard are being followed.

(c)(6)(i)(A) The periodic inspection shall be performed by an authorized employee other than the ones(s) utilizing the energy control procedure being inspected.

(c)(6)(i)(B)
The periodic inspection shall be conducted to correct any deviations or inadequacies identified.

(c)(6)(i)(C)
Where lockout is used for energy control, the periodic inspection shall include a review, between the inspector and each authorized employee, of that employee’s responsibilities under the energy control procedure being inspected.

(c)(6)(i)(D)
Where tagout is used for energy control, the periodic inspection shall include a review, between the inspector and each authorized and affected employee, of that employee’s responsibilities under the energy control procedure being inspected, and the elements set forth in paragraph (c)(7)(ii) of this section.

(c)(6)(ii)
The employer shall certify that the periodic inspections have been performed. The certification shall identify the machine or equipment on which the energy control procedure was being utilized, the date of the inspection, the employees included in the inspection, and the person performing the inspection.

(c)(7) Training and communication.

(c)(7)(i)
The employer shall provide training to ensure that the purpose and function of the energy control program are understood by employees and that the knowledge and skills required for the safe application, usage, and removal of the energy controls are acquired by employees. The training shall include the following:

(c)(7)(i)(A)
Each authorized employee shall receive training in the recognition of applicable hazardous energy sources, the type and magnitude of the energy available in the workplace, and the methods and means necessary for energy isolation and control.
(c)(7)(i)(B)
Each affected employee shall be instructed in the purpose and use of the energy control procedure.

(c)(7)(i)(C)
All other employees whose work operations are or may be in an area where energy control procedures may be utilized, shall be instructed about the procedure, and about the prohibition relating to attempts to restart or reenergize machines or equipment which are locked out or tagged out.

(c)(7)(ii)
When tagout systems are used, employees shall also be trained in the following limitations of tags:

(c)(7)(ii)(A)
Tags are essentially warning devices affixed to energy isolating devices, and do not provide the physical restraint on those devices that is provided by a lock.

(c)(7)(ii)(B)
When a tag is attached to an energy isolating means, it is not to be removed without authorization of the authorized person responsible for it, and it is never to be bypassed, ignored, or otherwise defeated.

(c)(7)(ii)(C)
Tags must be legible and understandable by all authorized employees, affected employees, and all other employees whose work operations are or may be in the area, in order to be effective.

(c)(7)(ii)(D)
Tags and their means of attachment must be made of materials which will withstand the environmental conditions encountered in the workplace.

(c)(7)(ii)(E)
Tags may evoke a false sense of security, and their meaning needs to be understood as part of the overall energy control program.
(c)(7)(ii)(F)
Tags must be securely attached to energy isolating devices so that they cannot be inadvertently or accidentally detached during use.

(c)(7)(iii)
Employee retraining.

(c)(7)(iii)(A)
Retraining shall be provided for all authorized and affected employees whenever there is a change in their job assignments, a change in machines, equipment or processes that present a new hazard, or when there is a change in the energy control procedures.

(c)(7)(iii)(B)
Additional retraining shall also be conducted whenever a periodic inspection under paragraph (c)(6) of this section reveals, or whenever the employer has reason to believe that there are deviations from or inadequacies in the employee's knowledge or use of the energy control procedures.

(c)(7)(iii)(C)
The retraining shall reestablish employee proficiency and introduce new or revised control methods and procedures, as necessary.

(c)(7)(iv)
The employer shall certify that employee training has been accomplished and is being kept up to date. The certification shall contain each employee's name and dates of training.

(c)(8)
Energy isolation. Lockout or tagout shall be performed only by the authorized employees who are performing the servicing or maintenance.

(c)(9)
Notification of employees. Affected employees shall be notified by the employer or authorized employee of the application and removal of lockout devices or tagout devices. Notification shall be given before the controls are
applied, and after they are removed from the machine or equipment.

(d)
Application of control. The established procedures for the application of energy control (the lockout or tagout procedures) shall cover the following elements and actions and shall be done in the following sequence:

(d)(1) Preparation for shutdown. Before an authorized or affected employee turns off a machine or equipment, the authorized employee shall have knowledge of the type and magnitude of the energy, the hazards of the energy to be controlled, and the method or means to control the energy.

(d)(2) Machine or equipment shutdown. The machine or equipment shall be turned off or shut down using the procedures established for the machine or equipment. An orderly shutdown must be utilized to avoid any additional or increased hazard(s) to employees as a result of the equipment stoppage.

(d)(3) Machine or equipment isolation. All energy isolating devices that are needed to control the energy to the machine or equipment shall be physically located and operated in such a manner as to isolate the machine or equipment from the energy source(s).

(d)(4) Lockout or tagout device application.

(d)(4)(i) Lockout or tagout devices shall be affixed to each energy isolating device by authorized employees.

(d)(4)(ii) Lockout devices, where used, shall be affixed in a manner to that will hold the energy isolating devices in a "safe" or "off" position.

(d)(4)(iii) Tagout devices, where used, shall be affixed in such a manner as will
clearly indicate that the operation or movement of energy isolating devices from the "safe" or "off" position is prohibited.

(d)(4)(iii)(A)
Where tagout devices are used with energy isolating devices designed with the capability of being locked, the tag attachment shall be fastened at the same point at which the lock would have been attached.

(d)(4)(iii)(B)
Where a tag cannot be affixed directly to the energy isolating device, the tag shall be located as close as safely possible to the device, in a position that will be immediately obvious to anyone attempting to operate the device.

(d)(5)
Stored energy.

(d)(5)(i)
Following the application of lockout or tagout devices to energy isolating devices, all potentially hazardous stored or residual energy shall be relieved, disconnected, restrained, and otherwise rendered safe.

(d)(5)(ii)
If there is a possibility of reaccumulation of stored energy to a hazardous level, verification of isolation shall be continued until the servicing or maintenance is completed, or until the possibility of such accumulation no longer exists.

(d)(6)
Verification of isolation. Prior to starting work on machines or equipment that have been locked out or tagged out, the authorized employee shall verify that isolation and deenergization of the machine or equipment have been accomplished.

(e)
Release from lockout or tagout. Before lockout or tagout devices are removed and energy is restored to the machine or equipment, procedures shall be followed and actions taken by the authorized employee(s) to ensure
the following:

(e)(1)
The machine or equipment. The work area shall be inspected to ensure that nonessential items have been removed and to ensure that machine or equipment components are operationally intact.

(e)(2)
Employees.

(e)(2)(i)
The work area shall be checked to ensure that all employees have been safely positioned or removed.

(e)(2)(ii)
After lockout or tagout devices have been removed and before a machine or equipment is started, affected employees shall be notified that the lockout or tagout device(s) have been removed.

(e)(3)
Lockout or tagout devices removal. Each lockout or tagout device shall be removed from each energy isolating device by the employee who applied the device. Exception to paragraph (e)(3): When the authorized employee who applied the lockout or tagout device is not available to remove it, that device may be removed under the direction of the employer, provided that specific procedures and training for such removal have been developed, documented and incorporated into the employer's energy control program. The employer shall demonstrate that the specific procedure provides equivalent safety to the removal of the device by the authorized employee who applied it. The specific procedure shall include at least the following elements:

(e)(3)(i)
Verification by the employer that the authorized employee who applied the device is not at the facility:
(e)(3)(ii)
Making all reasonable efforts to contact the authorized employee to inform him/her that his/her lockout or tagout device has been removed; and

(e)(3)(iii)
Ensuring that the authorized employee has this knowledge before he/she resumes work at that facility.

(f)
Additional requirements.

(f)(1)
Testing or positioning of machines, equipment or components thereof. In situations in which lockout or tagout devices must be temporarily removed from the energy isolating device and the machine or equipment energized to test or position the machine, equipment or component thereof, the following sequence of actions shall be followed:

(f)(1)(i)
Clear the machine or equipment of tools and materials in accordance with paragraph (e)(1) of this section;

(f)(1)(ii)
Remove employees from the machine or equipment area in accordance with paragraph (e)(2) of this section;

(f)(1)(iii)
Remove the lockout or tagout devices as specified in paragraph (e)(3) of this section;

(f)(1)(iv)
Energize and proceed with testing or positioning;

(f)(1)(v)
Deenergize all systems and reapply energy control measures in accordance
with paragraph (d) of this section to continue the servicing and/or maintenance.

(f)(2)
Outside personnel (contractors, etc.).

(f)(2)(i)
Whenever outside servicing personnel are to be engaged in activities covered by the scope and application of this standard, the on-site employer and the outside employer shall inform each other of their respective lockout or tagout procedures.

(f)(2)(ii)
The on-site employer shall ensure that his/her employees understand and comply with the restrictions and prohibitions of the outside employer's energy control program.

(f)(3)
Group lockout or tagout.

(f)(3)(i)
When servicing and/or maintenance is performed by a crew, craft, department or other group, they shall utilize a procedure which affords the employees a level of protection equivalent to that provided by the implementation of a personal lockout or tagout device.

(f)(3)(ii)
Group lockout or tagout devices shall be used in accordance with the procedures required by paragraph (c)(4) of this section including, but not necessarily limited to, the following specific requirements:

(f)(3)(ii)(A)
Primary responsibility is vested in an authorized employee for a set number of employees working under the protection of a group lockout or tagout device (such as an operations lock);
(f)(3)(ii)(B)
Provision for the authorized employee to ascertain the exposure status of individual group members with regard to the lockout or tagout of the machine or equipment and

(f)(3)(ii)(C)
When more than one crew, craft, department, etc. is involved, assignment of overall job-associated lockout or tagout control responsibility to an authorized employee designated to coordinate affected work forces and ensure continuity of protection; and

(f)(3)(ii)(D)
Each authorized employee shall affix a personal lockout or tagout device to the group lockout device, group lockbox, or comparable mechanism when he or she begins work, and shall remove those devices when he or she stops working on the machine or equipment being serviced or maintained.

(f)(4)
Shift or personnel changes. Specific procedures shall be utilized during shift or personnel changes to ensure the continuity of lockout or tagout protection, including provision for the orderly transfer of lockout or tagout device protection between off-going and oncoming employees, to minimize exposure to hazards from the unexpected energization or start-up of the machine or equipment, or the release of stored energy.

Note: The following appendix to §§1910.147 services as a non-mandatory guideline to assist employers and employees in complying with the requirements of this section, as well as to provide other helpful information. Nothing in the appendix adds to or detracts from any of the requirements of this section.

1910.147 App A
Standard Title: Typical minimal lockout procedures
SubPart Number: J

General

The following simple lockout procedure is provided to assist employers in developing their procedures so they meet the requirements of this standard. When the energy isolating devices are not lockable, tagout may be used, provided the employer complies with the provisions of the standard which require additional training and more rigorous periodic inspections. When tagout is used and the energy isolating devices are lockable, the employer must provide full employee protection (see paragraph (c)(3)) and additional training and more rigorous periodic inspections are required. For more complex systems, more comprehensive procedures may need to be developed, documented, and utilized.

Lockout Procedure

Lockout Procedure for

(Name of Company for single procedure or identification of equipment if multiple procedures are used).

Purpose
This procedure establishes the minimum requirements for the lockout of energy isolating devices whenever maintenance or servicing is done on machines or equipment. It shall be used to ensure that the machine or equipment is stopped, isolated from all potentially hazardous energy sources and locked out before employees perform any servicing or maintenance where the unexpected energization or start-up of the machine or equipment or release of stored energy could cause injury.

**Compliance With This Program**

All employees are required to comply with the restrictions and limitations imposed upon them during the use of lockout. The authorized employees are required to perform the lockout in accordance with this procedure. All employees, upon observing a machine or piece of equipment which is locked out to perform servicing or maintenance shall not attempt to start, energize, or use that machine or equipment.

**Sequence of Lockout**

1. Notify all affected employees that servicing or maintenance is required on a machine or equipment and that the machine or equipment must be shut down and locked out to perform the servicing or maintenance.

2. The authorized employee shall refer to the company procedure to identify the type and magnitude of the energy that the machine or equipment utilizes, shall understand the hazards of the energy, and shall know the methods to control the energy.

3. If the machine or equipment is operating, shut it down by the normal stopping procedure (depress the stop button, open switch, close valve, etc.).

4. De-activate the energy isolating device(s) so that the machine or equipment is isolated from the energy source(s).

5. Lock out the energy isolating device(s) with assigned individual lock(s).
(6) Stored or residual energy (such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure, etc.) must be dissipated or restrained by methods such as grounding, repositioning, blocking, bleeding down, etc.

(7) Ensure that the equipment is disconnected from the energy source(s) by first checking that no personnel are exposed, then verify the isolation of the equipment by operating the push button or other normal operating control(s) or by testing to make certain the equipment will not operate.

    Caution: Return operating control(s) to neutral or "off" position after verifying the isolation of the equipment.

(8) The machine or equipment is now locked out.

"Restoring Equipment to Service." When the servicing or maintenance is completed and the machine or equipment is ready to return to normal operating condition, the following steps shall be taken.

(1) Check the machine or equipment and the immediate area around the machine to ensure that nonessential items have been removed and that the machine or equipment components are operationally intact.

(2) Check the work area to ensure that all employees have been safely positioned or removed from the area.

(3) Verify that the controls are in neutral.

(4) Remove the lockout devices and reenergize the machine or equipment. Note: The removal of some forms of blocking may require reenergization of the machine before safe removal.

(5) Notify affected employees that the servicing or maintenance is completed and the machine or equipment is ready for used.

Selected Examples of
OSHA Letters of Interpretation

- **Standard Number:** 1910.147(e)(3)
- **Subject:** Removal of lockout devices by persons other than those who applied them.
- **Information Date:** 02/28/2000

February 28, 2000
Ms. Gretchen R. Busch
Project Manager, The Resource Effectiveness Development
Group
P.O. Box 247
Reynoldsburg, OH 43068

Dear Ms. Busch:

Thank you for your July 10, 1999 letter to the Occupational Safety and Health Administration’s (OSHA’s) Directorate of Compliance Programs

**Scenario:** Recently, one of my customers requested a written lockout/tagout program and I ran across some interpretations that I found both insightful and helpful. However, there is one interpretation that has raised some questions. The interpretation that I am referring to is dated July 28, 1995 from John B. Miles to Ms. Vicki Chouinard of Honeywell, Inc.

The specific question is in regard to using a master key on a lock when an authorized employee is not on site. The interpretation states that a master key is not acceptable and a bolt cutter [or equivalent means resulting in the destruction of the lock] must be used to remove the lock. After reviewing the 29 CFR 1910.147(e)(3) reference, I do not see any mention of the use of a master key as being unacceptable, nor conversely, the use of bolt cutters acceptable.

What I have found is that the regulation clearly states that the employer of the authorized employee may remove a lockout device as long as a documented procedure is followed. This procedure, at a minimum, must include: (1) verification by the employer that the [authorized] employee [who applied the device] is not on site; (2) [all] reasonable efforts to contact the authorized employee to inform him or her that the lock has been removed; and (3) the employee is definitely informed of the removal of the lock upon his or her return to work.

**Question:** Based on the above information and a very specific written procedure, isn”t it possible that an employer does have an alternative to bolt cutters as a way to remove lockout devices?

**Reply:** Bolt cutters, or other device-destructive methods, are not the only permissible means by which to remove a lockout device, if the employer can demonstrate that the specific alternative procedure, which the employer follows prior to removing the device, provides a degree of safety that is equivalent to the removal of the device by the authorized employee who first affixed it. The use of a master key to remove a lockout device would be deemed equivalent (to the removal of the lock by the person who applied it) only if it is performed under the employer”s direction and in accordance
with the requirements established in **1910.147(e)(3)**.

Obviously, the "one person, one lock, one key" practice is the preferred means and is accepted across industry lines, but it is not the only method to meet the language of the standard. However, prior to the use of the master key method, specific procedures and training, meeting the §§1910.147(e)(3) exception, must be developed, documented, and incorporated into your energy control program. Among the features essential to a compliant master key procedure is a reliable method to ensure that access to the master key will be carefully controlled by the employer such that only those persons authorized and trained to use the master key in accordance with the employer’s program can gain access.

Safety is ensured not through the use of a specific removal device, be it a master key or bolt-cutter; rather, it lies in effective procedures, careful training, and procedures designed to ensure accountability. The success of any employer’s energy control program, including lockout or tagout device removal actions, depends upon ensuring that its employees follow established, effective procedures, thereby respecting the sanctity of another employee’s lockout or tagout device.

Thank you for your interest in occupational safety and health. We hope this provides the clarification you were seeking and apologize for any confusion the earlier document may have caused. The interpretation in this letter supersedes the July 28, 1995 Honeywell, Inc. letter, which is hereby rescinded. As this letter demonstrates, OSHA’s re-examination of an issue may result in the clarification or correction of previously stated enforcement guidance. In the future, should you wish to verify that the guidance herein remains current or access the referenced information, you may consult OSHA’s website at **http://www.osha.gov**. If you have any further questions, please feel free to contact the Office of General Industry Compliance Assistance at (202) 693-1850.

Sincerely,

Richard E. Fairfax, Director
Directorate of Compliance Programs
FOOTNOTE (1) While your question does not specifically address tagout devices, please be aware that the destructive removal of the tagout device is required by the standard, and there is no equivalent "master key" concept for tagout devices. Tagout device attachment means must be of the non-reusable and non-releasable type. [See subsection 1910.147(c)(5)(ii)(C)(2).] The standard mandates non-reusable tagout devices in order to adequately protect the authorized employee who affixes the tagout device and to prevent other employees from removing the tagout device in a way that is not permitted. (Back to text)
requesting interpretative guidance for paragraph (c)(7) of 29 CFR 1910.146 - Permit-Required Confined Spaces (PRCS) standard. The responses to questions raised are set forth below.

**Question 1.** Is there a distinction under 29 C.F.R. §§ 1910.146(c)(7) between "eliminating" and "isolating" a hazard or are these terms synonymous?

**Answer.** There is no reference to the term "isolating" in paragraph (c)(7). In the context of paragraph (c)(7) these terms are not synonymous.

**Question 2.** May mechanical hazards be eliminated by compliance with §§ 1910.147?

**Answer.** Yes

**Question 3.** May mechanical hazards be eliminated by compliance with Subpart O covering machine guarding requirements?

**Answer.** Yes, as long as the guarding method chosen effectively protects the entrant performing tasks within the space.

**Question 4** May electrical hazards be eliminated by compliance with §§ 1910.147?

**Answer** Yes

[This document was edited on 10/25/99 to strike information that does not reflect OSHA policy.]

**Question 5.** May natural gas hazards be eliminated by isolating such hazards by the means set out in the definition of "isolation" in §§ 1910.146(b)?

**Answer.** Only the means identified in the definition of isolation which address a fluid flowing through pipe, lines or ducts would be appropriate.
They are blanking or blinding the pipe or conduit; misaligning or removing sections of lines, pipes, or ducts; as well as a double block and bleed system. The other means of isolation identified in the definition, lockout or tagout of all sources of energy or blocking or disconnecting all mechanical linkages would not be appropriate.

**Question 6.** May hydraulic energy hazards be eliminated by compliance with §§ 1910.147? If not, please describe how such hazards may be eliminated.

**Answer.** Yes, if the frame of reference is that the hydraulic energy is the source of power to drive or activate a device within the space. No, if the hydraulic (stored) energy in question is a fluid being prevented from flowing into the space by a single in-line valve (i.e., the hydraulic energy developed from an elevated tank). See discussion in question 5.

**Question 7.** Please describe how atmospheric hazards can be eliminated from a permit-required confined space in a manner to comply with §§ 1910.146(c)(7).

**Answer.** Paragraph (c)(7) does not apply where a permit space presents an atmospheric hazard or the potential to pose an atmospheric hazard. Therefore, the elimination of present or potential atmospheric hazards would not constitute compliance with paragraph (c)(7).

**Question 8.** May the potential for heat stress be eliminated by allowing a sufficient cool-down time before employees or contractors enter the confined space?

**Answer.** A qualified yes. The sufficiency of the cool-down time taken has to include not only the latent heat within the space but the active heat created by the anticipated work activities of the employees within the space and any personal protective equipment being worn.

Should you have further question on this response, please contact Mr. Don Kallstrom of my staff at (202) 219-8031 x 109.

Sincerely,

10-104
July 23, 1996

John B. Miles, Jr.
U.S. Dept. of Labor/OSHA
Room N-3468 F-P Building
200 Constitution Avenue, NW
Washington, DC 20210

Dear Mr. Miles:

I would like to request an interpretation of 29 C.F.R. 1910.146(c)(7).

Many of our clients attempt to re-classify permit-required confined spaces to non-permit-required confined spaces by isolating or eliminating the hazards within the permit spaces. It would be helpful if OSHA could clarify the conditions under which a permit-required confined space may be re-classified. Please address the following:

(1) Is there a distinction under 29 C.F.R. 1910.146(c)(7) between "eliminating" and "isolating" a hazard or are these terms synonymous?

(2) May mechanical hazards be eliminated by compliance with 1910.147?
(3) May mechanical hazards be eliminated by compliance with Subpart O covering machine guarding requirements?

(4) May electrical hazards be eliminated by compliance with 1910.147?

(5) May natural gas hazards be eliminated by isolating such hazards by the means set out in the definition of "isolation" in 1910.146(b)?

(6) May hydraulic energy hazards be eliminated by compliance with 1910.147? If not, please describe how such hazards may be eliminated.

(7) Please describe how atmospheric hazards can be eliminated from a permit-required confined space in a manner to comply with 1910.146(c)(7).

(8) May the potential for heat stress be eliminated by allowing a sufficient cool-down time before employees or contractors enter the confined space?

I look forward to receiving your response.

Sincerely,
William K. Principe

\[d^*\]

**Interpretation**

- **Standard Number:** 1910.146; 1910.147(a); 1910.147(c)(4)(i);
  1910.252

- **Subject:** Permit-required confined spaces and control of hazardous energy; vehicle LOTO.

- **Information Date:** 01/11/1996

10-106
January 11, 1996

Mr. J.A. Hoeh, Manager
Safety and Health
Praxair, Inc.
P.O. Box 237
Keasbey, NJ 08832

Dear Mr. Hoeh:

This is in response to your March 2, 1994, letter to Roger A. Clark, former Director of Compliance Programs, requesting clarification of 29 CFR 1910.146 - Permit-required confined spaces and 29 CFR 1910.147 - Control of hazardous energy (Lockout/Tagout) standards. Our responses to your questions are in the order in which they were asked in your letter. Please accept my apology for the delay in this response.

29 CFR 1910.146 - Permit-required confined spaces (PRCS)

Question 1.

If all hazards such as engulfment, hazardous gases, etc. have been removed from the permit-required confined space, but the space is a column where the potential for a fall exists would this require us to follow the full PRCS program or would either the alternate entry procedure or reclassification procedure be applicable?

Answer.

If all the hazards of a PRCS (see the 1910.146(b) definition) can be and in fact are eliminated and prevented from reoccurring in the permit space, and if the fall hazard is not inherent to the permit space then reclassification procedures of paragraph (c)(7) can be applied.

We believe the (c)(5) procedures are not appropriate because they address
a condition where an atmospheric hazard can only be controlled but cannot be eliminated.

Where there is potential for a fall hazard during entry or exit from the space, Subpart "D" of 29 CFR 1910 applies and fall protection will have to be provided. Even if you were to use a properly installed portable ladder, if the former contents compromised the slip resistance of the ladder rung, additional measures to prevent a fall would have to be employed.

Question 2.

We have a twelve foot diameter, twenty foot high tank open to atmosphere at the top. The tank has been emptied and we enter through a bottom manhole. The tank has atmospheric air with no contaminants. We want to cut or weld on piping within this tank. The piping contained lime slurry which has been removed and the lines purged. Would welding or cutting under these circumstances require the complete PRCS program?

NOTE: This response is based on the presumption that the tank has been classified by you as a PRCS and for some reason cannot be or has not been reclassified.

Answer.

Yes, as long as the permit space retains its classification of PRCS. If the space can be reclassified using paragraph (c)(7), then the answer below applies. Also, the employer must comply with the non-permit space requirements of 1910.146.

Question 3.

If a PRCS has been reclassified to a non-permit required confined space, would welding or torch work be allowed in the space?

Answer.

Yes, as long as the protective measures of Subpart Q - Welding, Cutting and Brazing prevent a hazard from developing. In this case the welding
standard **1910.252** addresses the hazards of welding in a confined space and therefore prevails over the **1910.146** standard as long as no other hazards are present.

You are reminded that all the protective measures of other standards are applicable to the work in this space. You are specifically directed to the following paragraphs of the **Subpart Q**[1910.252(a)(4)(i), 1910.252(b)(4)(i) to (vii), 1910.252(c)(4), 1910.252(c)(9), and 1910.252(c)(10)].

**29 CFR 1910.147 - Control of Hazardous Energy (Lockout/Tagout)**

**Question 1.**

Does 1910.147 apply to trucks, tractors and trailers in a garage when vehicle maintenance is performed?

**Answer.**

Yes, the **1910.147** standard applies to trucks, tractors, and trailers (which are considered "machines and equipment") on which employees perform service and maintenance and there is potential exposure to harmful energy.

**Question 2.**

If the standard does apply, would removal of the ignition key and chocking the wheels be sufficient to comply with the documentation exception of 1910.147(c)(4)(i)?

**Answer.**

Except in those situations where there is a potential for injury from stored energy removal, the ignition key and disconnection of the battery cable should eliminate the potential for unexpected energization during servicing and maintenance. Chocking the wheels of the vehicle being worked on is appropriate for those situations where the power train does not prevent the...
vehicle from movement.

[This document was edited on 03/30/00 to strike information that does not reflect OSHA policy.]

We have included another letter on the 1910.147 standard which we trust will further shed light on the issue of servicing of motor vehicles.

If you have further questions on these requests please contact either Don Kallstrom for 29 CFR 1910.146 or Ron Davies for 29 CFR 1910.147 by telephoning (202)219 8031.

Sincerely,

John B. Miles, Jr., Director
Directorate of Compliance Programs

Notes and Scribbles
(a) Protection of employees -

(a)(1) No employer shall permit an employee to work in such proximity to any part of an electric power circuit that the employee could contact the electric power circuit in the course of work, unless the employee is protected against electric shock by deenergizing the circuit and grounding it or by guarding it effectively by insulation or other means.

(a)(2) In work areas where the exact location of underground electric power lines is unknown, employees using jack-hammers, bars, or other hand tools which may contact a line shall be provided with insulated protective gloves.

(a)(3) Before work is begun the employer shall ascertain by inquiry or direct observation, or by instruments, whether any part of an energized electric power circuit, exposed or concealed, is so located that the performance of the work may bring any person, tool, or machine into physical or electrical contact with the electric power circuit. The employer shall post and maintain proper warning signs where such a circuit exists. The employer shall advise employees of the location of such lines, the hazards involved, and the protective measures to be taken.

(b) Passageways and open spaces -

(b)(1) Barriers or other means of guarding shall be provided to ensure that

*Downloaded from www.osha.gov on 12/25/00. Bold type has been added to paragraph headings.
workspace for electrical equipment will not be used as a passageway during periods when energized parts of electrical equipment are exposed.

(b)(2)
Working spaces, walkways, and similar locations shall be kept clear of cords so as not to create a hazard to employees.

(c)
Load ratings. In existing installations, no changes in circuit protection shall be made to increase the load in excess of the load rating of the circuit wiring.

(d)
Fuses. When fuses are installed or removed with one or both terminals energized, special tools insulated for the voltage shall be used.

(e)
Cords and cables.

(e)(1)
Worn or frayed electric cords or cables shall not be used.

(e)(2)
Extension cords shall not be fastened with staples, hung from nails, or suspended by wire.

[58 FR 35179, June 30, 1993; 61 FR 9227, March 7, 1996; 61 FR 41738, August 12, 1996]
(a) **Controls.** Controls that are to be deactivated during the course of work on energized or deenergized equipment or circuits shall be tagged.

(b) **Equipment and circuits.** Equipment or circuits that are deenergized shall be rendered inoperative and shall have tags attached at all points where such equipment or circuits can be energized.

(c) **Tags.** Tags shall be placed to identify plainly the equipment or circuits being worked on.

[58 FR 35181, June 30, 1993; 61 FR 9227, March 7, 1996; 61 FR 41738, August 12, 1996]

*Downloaded from www.osha.gov on 12/25/00. Bold type has been added to paragraph headings.*
Notes and Scribbles
**CHAPTER ELEVEN**

**Glossary**

<table>
<thead>
<tr>
<th>Term</th>
<th>Definition</th>
</tr>
</thead>
<tbody>
<tr>
<td>Acute Effects.</td>
<td>Toxic effects which occur over a relatively short period of time (minutes, hours)</td>
</tr>
<tr>
<td>Acute Exposure.</td>
<td>Exposure once or only a few times over a short period of time: e.g. seventy-two hours</td>
</tr>
<tr>
<td>Affected employee</td>
<td>An employee whose job requires him/her to operate or use a machine or equipment on which servicing or maintenance is being performed under lockout or tagout, or whose job requires him/her to work in an area in which such servicing or maintenance is being performed.</td>
</tr>
<tr>
<td>Air Exchange</td>
<td>The addition of a volume of air equal to the volume of the space being ventilated with the removal of an equal amount of air from the space. One air exchange dilutes, but does not totally replace, the existing air in the space.</td>
</tr>
<tr>
<td>Air-Supplied Respirators</td>
<td>Make use of a hose to deliver clean, safe air from a stationary source of compressed breathing air; provide clean air for long periods of time and are light weight for the user; limit the range of user-mobility and may fail due to hose or airline damage; also called airline respirators; are normally used when there are extended work periods required in atmospheres that are not IDLH</td>
</tr>
<tr>
<td>Ambient</td>
<td>Usual or surrounding conditions of temperature, humidity, air, etc.</td>
</tr>
<tr>
<td>APR</td>
<td>Air Purifying Respirator; negative pressure</td>
</tr>
<tr>
<td>APF</td>
<td>Assigned Protection Factor</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>----------------------</td>
<td>-------------------------------------------------------------------------------------------------------------------------------------------</td>
</tr>
<tr>
<td>Asphyxiant</td>
<td>Gas that is essentially non-toxic, but can cause unconsciousness or death by lowering the concentration of oxygen in the air or by totally replacing the oxygen in breathing air (simple); a substance that interferes with the respiratory process, e.g., carbon dioxide, nitrogen, hydrogen, and helium (chemical)</td>
</tr>
<tr>
<td>Asphyxiation</td>
<td>Medical condition: impaired or absent exchange of oxygen and carbon dioxide in breathing; build up of carbon monoxide in blood and tissues; suffocation</td>
</tr>
<tr>
<td>atm</td>
<td>Atmosphere; a measure of air pressure; 1 atm = 760 mmHg; 14.7 psi; 29.92 inches Hg, 407 inches w.g. (water gauge), or 101 kPa</td>
</tr>
<tr>
<td>Authorized employee</td>
<td>A person who locks out or tags out machines or equipment in order to perform servicing or maintenance on that machine or equipment.</td>
</tr>
<tr>
<td>Autoignition Temperature</td>
<td>Minimum temperature of a solid, liquid, or gas required to initiate or cause self-sustained combustion in air with no other source of ignition. Also called the hot-flame reaction threshold temperature</td>
</tr>
<tr>
<td>Blanking/Blinding</td>
<td>Closing a pipe, line, or duct by fastening a solid plate (a spectacle blind or a skillet/pancake blind) that completely covers the bore. The blind must be able to withstand the maximum pressure of the pipe, line, or duct with no leakage.</td>
</tr>
<tr>
<td>BP</td>
<td>Boiling Point. The temperature at which the vapor pressure a liquid equals the ambient atmosphere pressure</td>
</tr>
<tr>
<td>BTT</td>
<td>Break Through Time; permeation rate</td>
</tr>
<tr>
<td>Term</td>
<td>Definition</td>
</tr>
<tr>
<td>------</td>
<td>------------</td>
</tr>
<tr>
<td>Cartridge or Cannister...</td>
<td>Container with a filter element, sorbent, or catalyst, or combination of these items, which removes specific contaminants from the air passed through the container; APR</td>
</tr>
<tr>
<td>Caustics.......</td>
<td>A large class of substances that form solution having a high pH; strongly alkaline; usually refers to bases; strongly irritates, burns, corrodes, or destroys living tissue</td>
</tr>
<tr>
<td>cfm.............</td>
<td>Cubic feet per minute</td>
</tr>
<tr>
<td>cfs.............</td>
<td>Cubic feet per second</td>
</tr>
<tr>
<td>CFR.............</td>
<td>Code of Federal Regulations</td>
</tr>
<tr>
<td>CGI.............</td>
<td>Combustible Gas Indicator (monitor)</td>
</tr>
<tr>
<td>Chronic.......</td>
<td>Of long duration; chronic exposure usually refers to long-term, low-level exposure</td>
</tr>
<tr>
<td>CIH.............</td>
<td>Certified Industrial Hygienist</td>
</tr>
<tr>
<td>cm.............</td>
<td>Centimeter; measure of length; 1 cm = 0.394</td>
</tr>
<tr>
<td>cm².............</td>
<td>Square Centimeter; measure of area; 1 cm² = 0.155&quot;²</td>
</tr>
<tr>
<td>cm³ or cc......</td>
<td>Cubic Centimeter; measure of volume; 1 cm³ = a sugar cube</td>
</tr>
<tr>
<td>CO.............</td>
<td>Carbon Monoxide</td>
</tr>
<tr>
<td>CO₂ ..........</td>
<td>Carbon Dioxide</td>
</tr>
<tr>
<td>Combustible Liquid.......</td>
<td>Has a flashpoint of 100°F or higher.</td>
</tr>
<tr>
<td>Combustibility.</td>
<td>Ability of a material to act as a fuel and to sustain a fire</td>
</tr>
</tbody>
</table>
Combustion.... An oxidative chemical process. It produces energy as heat and often as light. Combustion is called fire when the oxidative process occurs fast enough to be self sustaining. Combustion that produces a sudden and violent release of energy is called an explosion.

Concentration. Amount of a given substance in a stated unit of measure

Confined Space From Neil McManus, Safety and Health in Confined Spaces, Lewis Publishers: Lewis Publishers, Boca Raton, 1999; pp. 252-253: As a working definition, the term “confined space/confined atmosphere/confined energy” could apply to work-places inside which one or more of the following hazardous conditions could be present or could develop:
- Personal confinement
- Unstable interior condition
- Flowable solid materials or residual liquids or sludges
- Release of energy through uncontrolled or unpredicted motion or action of equipment
- Atmosphere confinement
  - Toxic substances
  - Oxygen deficiency/enrichment
  - Flammable/combustible atmosphere
- Chemical, physical, biological, ergonomic, mechanical, process, and safety hazards

Confined Space From NIOSH: its definition of confined spaces contains the following elements:
- Limited openings for entry and exit by design
- Unfavorable natural ventilation that could contain or produce dangerous air contaminants
- Not intended for continuous employee occupancy

Confined Space

From **OSHA**: its definition of confined spaces contains the following criteria:
- An enclosed or partially enclosed workspace
- Limited means of entry and exit
- Subject to accumulation of toxic or flammable contaminants
- May develop an oxygen deficiency
- Not intended for continuous employee occupancy

**CPC............**

Chemical Protective Clothing

**Dilution Ventilation**

Mechanical addition of uncontaminated air to contaminated air to control potential airborne hazards.

**Displacement Ventilation**

A ventilation technique that removes gases and vapors from the interior of the space on the basis of density. Through careful positioning if the injection point and control of injection rate, the displacing gas and the resident gas will form stratified layers. Under controlled conditions, the volume of gas needed to displace the contents is 1.5 to 2.5 times the volume of the container. A serious hazard still exists if follow-up ventilation is not provided since the displacing gas may remain in the space.

**Dose.......**

Term used to express the amount of exposure to a chemical substance

**DOT.........**

Dusts......... Particles produced by the breakdown of solid materials; dusts include fibrous particles that have longitudinal geometry and particles that have regular or irregular compact geometry

Effective Air Flow The amount of air actually passing through a ventilation system in a unit of time. Usually expressed in cubic feet per minute (cfm). The effective air flow is always less than the rated air flow.

EL.............. Excursion Limit

Engineering Controls.... Methods of controlling employee exposures by modifying the source or reducing the quantity of the hazards; methods include substitution, ventilation, isolation, and enclosure

Engulfment ... The surrounding and capture of a person by a liquid or finely divided solid (such as grain) that can cause death by drowning or that exerts enough force to strangle, constrict, or crush a person.

Entry Permit . Written document provided by the employer to allow and control entry into a permit-required confined space. Must contain all the information detailed in paragraph (f) of 1910.146.

ESLI............. End-of-service life Indicator on filters; system that warns the respirator user of the approach of the end of adequate respiratory protection

Explosion...... Bursting or rupture of an enclosure or container because of the development of internal pressure. Also see combustion

Explosive Limits. The amounts of vapor in the air that form explosive mixtures; limits are expressed as lower and upper limits and give the range of vapor concentrations in
the air that will explode (explosive or flammability range) if an ignition source is present

Exposure...... Contact between a substance and a potentially affected biological system that permits transaction

°F.............. Fahrenheit; °F = (°C x 9/5) + 32; °C = (°F - 32) x 5/9

FF.............. Fit Factor; quantitative estimate of the fit of a particular respirator to a specific individual, and typically estimates the ratio of the concentration of a substance in ambient air to its concentration inside the respirator when worn; OSHA

Filtering Facepiece. Particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of filtering medium; single-use and disposable; NIOSH Dust mask; negative pressure particulate respirator with a filter as an integral part of the facepiece or with the entire facepiece composed of the filtering medium; OSHA

Flammable... A material is flammable if it can be ignited easily and burn quickly.

Flammable Liquid. Has a flash point less than 100°F

Fl.P or FP..... Flash Point. The lowest temperature at which a liquid gives off enough flammable vapors at or near its surface that it ignites in a mixture with air and an ignition source

g.............. Gram; measure of weight; 1 g = 0.035 oz, 1 oz = 24.8 g; the weight of one milliliter of water

Gas.......... State of matter in which the material can expand and contract greatly in response to changes in temperature and pressure; easily diffuses; neither a solid nor a liquid.
Gas & Vapor Respirators. Are normally used when there are only hazardous gases and vapors in the air; use chemical filters (called cartridges or canisters) to remove dangerous gases and vapors; do not protect against airborne particulates; are made to protect against specific gases or vapors; provide protection only as long as the filter’s absorbing capacity is not depleted; the service life of the filter depends upon many factors and can be estimated in various ways; APR

Hazard......... Unsafe condition which, if left uncontrolled, can contribute to an incident; Health hazard: a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees

Hazardous Atmosphere. An atmosphere that presents a risk of death, injury, or acute illness, or which makes self-rescue from a confined space impossible. The five (5) causes of a hazardous atmosphere are:
  - Concentration of a flammable gas, vapor, or mist that is above the 10% of its LEL (lower explosive limit)
  - Concentration of a combustible dust at or above its LEL (roughly the concentration which obscures vision at five feet or less)
  - Oxygen concentration below 19.5% or above 23.5%
  - Concentration of any substance for which the PEL (or dose) is listed in either OSHA Subparts G or Z that is above the listed exposure limit
  - Any other atmospheric condition that is IDLH
<table>
<thead>
<tr>
<th><strong>Hot Work Permit</strong></th>
<th>Employer’s written permission to perform work (such as welding, burning, cutting, heating, or riveting that could provide a source of ignition)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>IDLH</strong></td>
<td>Immediately Dangerous to Life or Health; acute respiratory exposure that poses an immediate threat of loss of life, immediate or delayed irreversible adverse effects of health, or acute eye exposure that would prevent escape from hazardous atmosphere; NIOSH</td>
</tr>
<tr>
<td><strong>Ignition Source.</strong></td>
<td>May include heat, sparks, flames, static electricity, and friction</td>
</tr>
<tr>
<td><strong>Ignition Temperature</strong></td>
<td>Minimum temperature to which substance must be raised before it will ignite</td>
</tr>
<tr>
<td><strong>Industrial Hygiene</strong></td>
<td>Profession devoted to the recognition, evaluation, and control of those environmental factors or stresses (i.e., chemical, physical, biological, and ergonomic) that may cause sickness, impaired health, or significant discomfort to employees</td>
</tr>
<tr>
<td><strong>Inerting</strong></td>
<td>Involves creating or maintaining an inert atmosphere in the space at all times during critical aspects of a work cycle. Therefore, the “inertness”, meaning low level of oxygen (oxygen deficient), must be maintained using the appropriate gas.</td>
</tr>
<tr>
<td><strong>Intrinsically Safe</strong></td>
<td>Electronic equipment and associated wiring, such as sampling meters and pumps, that are certified to be incapable of causing ignition of a mixture of flammable or combustible material in air in its most easily ignitable concentration.</td>
</tr>
<tr>
<td><strong>Isolation</strong></td>
<td>Process of separating a confined space from all sources of energy and from all incoming chemicals and materials. Locking-out all energy, disconnecting mechanical drives, blanking/binding</td>
</tr>
</tbody>
</table>
pipes, lines, and ducts are ways to isolate a confined space prior to entry

LEL............ Lower Explosive Limit

Local Exhaust Ventilation A system consisting of a blower, duct and hood that draw contaminants away from the worker and that prevents them from entering the work space.

LO/TO......... Lockout/Tagout; 29CFR1910.147

m.............. Meter; measure of length; 1 m=3.281 ft; 1 m=100 cm

m²............. Square Meter; measure of area; 1 m² = 10.764 ft²

m³ or cu m... Cubic Meter; measure of volume; 35.315 ft³

Make Up Air Air that is added to a space to replace air that is drawn out by a mechanical ventilation system.

mg............ Milligram; 1/1000 g or 0.001 g

MSDS.......... Material Safety Data Sheet

MUL or MUC.. Maximum Use Level or Concentration = PEL x PF

NFPA.......... National Fire Protection Association; http://www.nfpa.org

NFPA Hazard Rating A visual system that addresses the health, flammability, reactivity, and related hazards which may exist due to a short-term, acute exposure caused by a fire, spill, or similar emergency; it does not apply to chronic exposure or to non-emergency occupational exposure

NIOSH......... National Institute for Occupational Safety & Health; http://www.cdc.gov/niosh/homepage.html; for
Pocket Guide on-line = cdc.gov/niosh/npg/pgdstart.html; 800-356-4674

O₂ ............. Oxygen

OSHA.......... Occupational Safety & Health Administration; DOL; 800-321-472; http://www.osha.gov

Oxygen Deficient OSHA: when the percentage of oxygen in the air we breathe is below 19.5% (normal is approx. 20.9)

Oxygen Enriched OSHA: when the percentage of oxygen in the air we breathe exceeds 23.5%

PAPR.......... Power Air Purifying Respirator uses a blower to force the ambient air through air-purifying elements to the inlet covering

PEL.......... Permissible Exposure Limit (OSHA); unless otherwise note, PELs are TWA concentrations that must not be exceeded during any 8-hour work shift; legally enforceable

PF.......... Protection Factor

Piloted Ignition Occurs through supply of energy from an external source – a flame, spark, or glowing object (ember)

PPE.......... Personal Protective Equipment

PRCS.......... Permit-required Confined Space

psf.......... Pounds per Square Foot

psi.......... Pounds per Square Inch

ppm.......... Parts per Million; equiv. to 1" in 16.7 miles or 100 ppm = 1 teaspoon in 1300 gallons
<table>
<thead>
<tr>
<th>Term</th>
<th>Definition/Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>Purging Ventilation</td>
<td>Is a ventilation process involving gases other than air. These gases generally include “inert” gases such as steam, nitrogen, carbon dioxide, and helium. Purging ventilates or flushes the space while avoiding contact between the contents and other gases or vapors from the space by dilution or displacement. Purging also can remove volatiles that may be emitted by sludges or residues or from the structure itself.</td>
</tr>
<tr>
<td>Rated Air Flow</td>
<td>The Volume of Air that a blower can deliver in a unit of time when no hose, duct, or other restriction is in place.</td>
</tr>
<tr>
<td>Reactivity</td>
<td>Characteristic of a chemical that is normally unstable; reacts violently with water; generates toxic gases; vapors, or fumes; or detonates or explodes under more or less normal conditions or handling.</td>
</tr>
<tr>
<td>REL</td>
<td>Recommended Exposure Limit (NIOSH)</td>
</tr>
<tr>
<td>Respirable</td>
<td>Capable of being inhaled</td>
</tr>
<tr>
<td>Risk</td>
<td>The probability that something will cause harm, combined with potential severity of that harm</td>
</tr>
<tr>
<td>Routes of Entry</td>
<td>Routes of entry and contact for toxic substances; “Inh” is inhalation; “Abs” is absorption; “Ing” is ingestion; “Con” is skin or eye contact; Injection is another route of entry.</td>
</tr>
<tr>
<td>Safety</td>
<td>Control of hazards to attain an acceptable level of risk</td>
</tr>
<tr>
<td>SAR</td>
<td>Supplied Air Respirator; see “air-supplied respirator”</td>
</tr>
</tbody>
</table>
| SCBA                         | Self-contained Breathing Apparatus consists of a
wearable, clean-air supply pack; does not restrict movement with a airline connection; are normally used when there is a short-time need to enter and escape from atmospheres which are or may be IDLH; unit usually weighs between 22 - 40 pounds

Solvent........ A liquid capable of dissolving another substance. Many solvents are organic, or carbon-based; many of these are volatile, flammable, and toxic. Water in an inorganic solvent.

Sp. Gr........ Specific Gravity (H₂O = 1); The ratio of the density of a substance to the density of water

STEL or ST... Short-term Exposure Limit; unless otherwise noted, the STEL is a 15 minute TWA exposure that should not be exceeded at any time during the workday

TLV............ Threshold Limit Value (ACGIH)

Toxicity........ Ability of a substance to cause damage to biological tissue or systems

Toxicology... The study of poisons

TWA............ Time Weighted Average

UEL............. Upper Explosive Limit

Vapor......... The gaseous phase of something that is usually a liquid or a solid

Vapor Density The “heaviness” of vapor from a chemical compared to air (air = 1); MW of a chemical divided by 29 = VD.

VD or RgasD. Vapor Density; Relative Gas Density

Volatile........ Percent volatile by volume; the percentage of a
liquid or solid (by volume) that will evaporate at an ambient temperature of 70° F; gasoline and paint thinner are 100% volatile

Volatilization. Changing of a liquid to a vapor

VP.............. Vapor Pressure (mmHg); Pressure exerted by a vapor; increases with heat; pressure greater than 10 mmHg is considered to be high.

ENVIRONMENTAL, HEALTH, AND SAFETY WEB SITES

cdc.gov/niosh/homepage.html
  (National Institute for Occupational Safety & Health

cdc.gov/niosh/npg/pgdstart.html
  (NIOSH Pocket Guide On-Line

cdc.gov/niosh/respinfo.html
  (NIOSH Respirator Home Page; 42 CFR Part 84

cpwr.com
  (Center to Protect Workers Rights

crossroads.nsc.org/chemicals.cfm
  (National Safety Council; chemical backgrounds, not MSDSs

eLCOSH.com
  (CPWR/NIOSH Electronic Library of Construction Safety and Health

hazmat.dot.gov/hazhome.htm
  (DOT Office of Hazardous Materials Safety; ERG2000 on-line; regulations, more

osha.gov
  (Occupational Safety & Health Administration; DOL