Confined Space
Pocket Guide

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They called it “the pit.” It was really more like a concrete tunnel running under the main floor at the back of the plant. It was a good seventy-five feet long, but not much more than five feet square. “The pit” was dark and dusty, with pipes of various diameters - all unmarked, some unused - running in and out of it at crazy angles. Two of the three original access points had been covered over by pieces of heavy machinery. The only access left was through a twenty-four inch “manhole” covered by a rusting iron grate. The light filtering through the grate was weak and quickly consumed by darkness.

People joked about “the pit,” saying there were rats down there the size of Volkswagens. For what most of them knew, it could have been true.

All Danny knew was that the stink was beginning to ruin his day. The grate sat no more than ten feet from his work area, and after three days of inhaling that noxious brew, he’d had enough.

Danny had been there twenty years and he knew there weren’t any rats down there; well, none the size of a VW! When he first started with the company, he was in maintenance and, on occasion, had to slip his wiry frame into the pit through various access points to “wrench” on a valve or “chase” a pipe. He couldn’t remember the last time he’d ventured into it.

Armed with a flashlight (and a twelve-inch crescent wrench for the rats), he ambled toward “the pit.” Using the heel of his work boot, he pushed the heavy grate over the lip of the manhole. The scraping sound of heavy iron echoed in the black void. He played the flashlight’s beam down through the opening and across the floor. It was dry and dusty; particles of rust danced in the shaft of light.

With his legs dangling over the edge of the access hole, he rocked his hips forward and dropped into the darkness to see what he could see. Danny didn’t see a thing. He died.
I’m Jimmy Molenski, “Mole” to my friends, and what you just read is true. I’m the one who pulled Danny’s lifeless body from that hole. And what killed Danny kills or injures countless numbers of workers every year in this country. I’m talking about confined spaces. Confined spaces present a unique environment in which hazards or dangers that would be found in any typical work situation can rapidly escalate to fatal proportions. I know. I’ve been working in confined spaces for more years than I can count (they don’t call me “Mole” for nothing), and I’m living proof that it can be done safely - if you know what you’re doing. And if you’re around or involved in confined space work and want to remain healthy and happy, you need to learn some basic facts. You were given this guide so you can learn to avoid the mistakes that have cost others their health, or like Danny, their lives. In this booklet, we’ll look at the types of hazards present in confined space work. We’ll also see how these hazards can be detected and monitored, and we’ll discuss the types of personal protective equipment needed. I’ll explain the standard for confined spaces. It was written to help your employer ensure your health and safety when working in or around confined spaces. We’ll also look at rescue and first aid guidelines as required by the standard. A glossary of terms commonly used in confined space work is included. If you don’t understand something contained in this guide, ask your supervisor for help.

If you take the time to read and remember this information, you’ll be in a much better position to safely work in confined spaces. If you don’t . . . the next emergency call I get may be for you!

First, let’s take a look at the law and how it was written to protect your health and safety.
I. Review of the Law

The law, or standard, is an amendment to Part 1910 (Title 29 CFR subpart J) of the Occupational Safety and Standard. This amendment is entitled “1910.146 Permit Required Confined Spaces.”

What is a permit required confined space (PRCS)? Well, it’s kinda like a confined space with some extra added attractions. It’s a space large enough for an employee to bodily enter and perform assigned work, has limited or restricted means for entry and exit, and is not designed for continuous employee occupancy.

A permit required confined space (PRCS) is, therefore, a confined space with one or more of the following characteristics:

• Contains or has the potential to contain a hazardous atmosphere.

• Contains a material that has the potential for engulfment of the entrant.

• Has an internal configuration such that an entrant could be trapped or asphyxiated (such as sloping walls or floors that reduce the area to a point of constriction).

• Contains any other recognized serious safety or health hazard.

If your employer determines that a permit required confined space (PRCS) exists, he must then inform all exposed employees by posting appropriate danger signs.

If your employer decides that no one will be permitted to enter a PRCS, then he must use procedures (i.e. locks or other effective barriers) to prevent employee entrance.

If your employer hires outside contractors to do PRCS work, he becomes the “host employer” and must provide the contractor or “other employer” with all available information regarding the hazards present in the permit space, along with any applicable safety and rescue procedures.
II. Hazard Recognition

I think it’s safe to say that you can now appreciate the fact that there are hazards present in confined space work. But can you list them all? I bet you can’t, but it’s okay, because that’s the purpose of the written permit system. The more familiar you are with the types of hazards present, the less likely you are to become a victim of them. That’s what we’re going to discuss next. We’ll look at the three classes of hazards present in confined space work, punctuated by stories of people who fell victim to them. These are real stories about real people. One could be about you!

The three classes of hazards of concern in confined space work are:

1. **Engulfment**
2. **Mechanical Hazards**
3. **Atmospheric Hazards**
   a. Oxygen Deficiency
   b. Flammables/Explosives
   c. Toxic Hazards

1. **Engulfment**

A group of employees at a Nebraska sawmill entered a 40-foot high storage tank, thought to be nearly full of sawdust. Entry was made through a small opening near the top. One of the workers suddenly disappeared. He fell into an air pocket in the sawdust. Rescue operations began immediately, but the worker had died from asphyxiation by the time his body was recovered. Two years earlier, this same employee had narrowly escaped death in a similar incident only because his foreman saw him sinking into the sawdust and managed to grab his hand to pull him out.

*OSHA’s report on the fatal incident quotes the sawmill’s report,* “... investigation of the earlier, non-fatal incident, which concluded
III. Hazard Assessment
(Monitoring)

The second requirement under the entry permit program is hazard identification. Listing the hazards of the permit space on the written permit is the first thing mentioned in the permit system. In addition, there are specific requirements for entrants to monitor for hazards under the special permit section of the standard.

If this doesn’t give you the impression that measuring and monitoring for atmospheric hazards is one of the most important things to remember when doing confined space work, then you need to go back and read some of those horror stories again.

Oxygen

The first and most important atmospheric test made in a PRCS is for oxygen content. This is because the very nature of a confined space results in a limited volume of air. A confined space also tends to act as a barrier to air movement. These two factors, limited volume and poor exchange, make monitoring for oxygen content a must.

How do you measure for oxygen content? Under the standard, 19.5% is the minimum and 23.5% is the maximum range for oxygen in a PRCS. Most oxygen-measuring instruments read in this range. How do these instruments work? Typically, there is an electrochemical sensor that reacts with the oxygen as it’s drawn into the sensor through a pump or allowed to diffuse naturally into the sensor. This reaction produces a very small electrical current whose strength is directly proportional to the oxygen content of the air being sampled. This current is then displayed as a percentage of total oxygen in air, either
IV. Equipment

When you think of equipment for confined work, you probably think of personal protective equipment, such as respirators and clothing. PPE is an important part of that equipment, but there is equipment that you should first get your hands on after the confined space has been measured for, flammable, and toxic levels.

Ventilation

Once the hazards have been assessed, engineering controls are used to try to bring them into compliance (remember 19.5% O₂ by volume, less than 10% LEL for flammables and no toxics exceeding their TLVs). Most experts agree that ventilation is the preferred method. There are three basic types of ventilation in confined space work:

1. Purging

Initial ventilation, called purging, is the first step in removing or displacing unwanted contaminants from a confined space. Purging may be done using an inert gas (such as nitrogen), water, steam and/or a cleaning solution, non-reactive with the contaminant. Forced air ventilation is used to remove other purging agents. Generally, 20 air exchanges (the internal volume of the confined space x 20) are considered sufficient to make the atmosphere in the confined space equal to the external atmosphere.

2. General Ventilation

The ventilation required to maintain a safe working environment. This may sound simple, but it’s not. The requirements for maintaining proper ventilation are based on many factors involving empirical and theoretical air velocity parameters. Therefore, ventila-
V. Rescue/First Aid

Would you believe 60% of the fatalities in confined space accidents are the result of misguided rescue attempts? It’s true! Here’s one more story for you.

A Connecticut fuel company owner sent an employee into a large underground vault. The vault’s only means of access and ventilation was straight down through 6 feet of 30-inch steel culvert pipe. The employer reportedly told police that he heard a ‘clunk’ soon after his employee descended into the vault. Concerned because they had lost contact with him, he sent in a second employee. This rescuer collapsed at the foot of the ladder. The employer then directed a third employee to go in to help the others. The second rescuer collapsed before he got to the bottom of the ladder, with one leg caught between two rungs. This hung the employee upside-down, interfering with rescue efforts by the firemen summoned to the scene.

Both rescuers were pronounced dead at the scene. The initial entrant died two days later from massive brain damage caused by prolonged oxygen deprivation.

OSHA subsequently learned from police department records that approximately six years earlier, two employees were overcome by lack of oxygen in a similar vault operated by the same employer. In that case, the entrants were rescued without loss of life. Unfortunately, the employer had not taken advantage of that ‘close call’ incident by implementing procedures which would have prevented subsequent incidents.

Armed with the knowledge gained by what you’ve read so far, it’s almost impossible to fathom why this had to happen, isn’t it? A proper entry permit program and written permit system would have prevented the first man from entering the confined space. The employer would have assessed the hazards present and a written procedure for entry
VI. Ten Safety Tips

Here's some advice that you should memorize, at least keep handy. These ten little tips could keep you out of big, big trouble.

1. *Never* enter a confined space before all hazards (atmospheric, engulfment, and mechanical) have been identified and procedures have been developed to deal with them.

2. *Always* isolate the confined space from all unwanted energy sources or hazardous substances using blanking, blinding, double block and bleed, or lock out/tag out methods.

3. *Always* maintain proper mechanical ventilation in the confined space and make sure ventilation equipment doesn’t interfere with entry, exit, and rescue procedures.

4. *Never* introduce hazards, such as welding, cleaning solvents, etc., in a confined space without first making provisions for these hazards and incorporating the provisions into the written permit system.

5. *Always* monitor for atmospheric hazards (oxygen, combustibles, toxics) prior to and during entry.

6. *Always* provide barriers, as necessary, to warn unauthorized personnel and to keep entrants safe from external hazards.

7. *Never* re-enter a non permit confined space once a hazard has been detected until the space has been re-evaluated and applicable procedures are in place.

8. *Always* provide constant communications between entrants and outside attendants, and remember to have backup communications if using two-way radios.

9. *Always* wear the personal protective
VII. Glossary

**Acceptable environmental conditions.** 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.

**Acid.** An inorganic or organic compound that: 1) reacts with metals to yield hydrogen; 2) reacts with a base to form a salt; 3) dissociates in water to yield hydrogen ions; 4) has a pH of less than 7.0; 5) neutralizes bases or alkalis. All acids contain hydrogen and turn litmus paper red. They are corrosive to human tissue and are to be handled with care. See Base; pH.

**Action level.** The exposure level (concentration in air) at which OSHA regulations to protect employees take effect (29 CFR 1910.1001-1047); e.g. workplace air analysis, employee training, medical monitoring, and record keeping. Exposure at or above action level is termed occupational exposure. Exposure below this level can also be harmful. This level is generally half the PEL.

**Aerobic.** Having oxygen (O₂) as part of the environment; growing only in the presence of oxygen, such as aerobic organisms; occurring only in the presence of oxygen, such as aerobic decomposition.

**Alkali.** Any compound having highly basic properties; i.e one that readily ionizes in aqueous solution to yield OH anions, with a pH above 7, and turns litmus paper blue. Examples are oxides and hydroxides of certain metals belonging to group IA of the periodic table (Li, Na, K, Rb, Cs, Fr). Ammonia and amines may also be alkaline. Alkalis are caustic and dissolve human tissue. Treat alkali burns by quickly washing the affected area with large amounts of water for at least 15