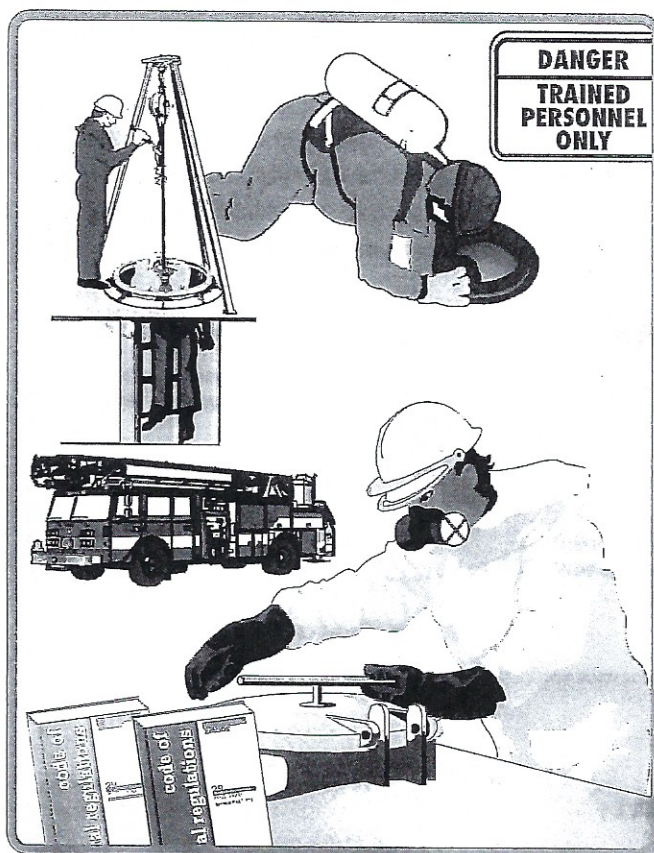


Confined Spaces



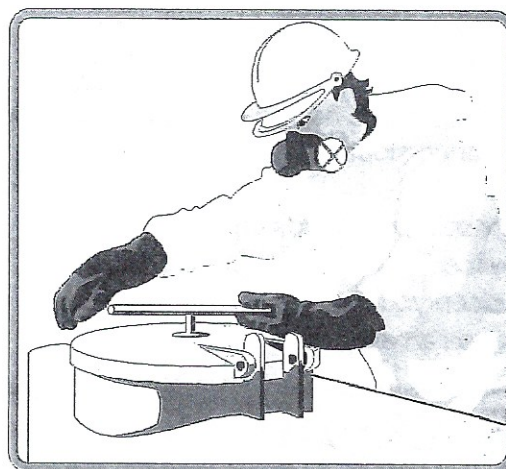
What Is a Confined Space?

A *confined space* has these characteristics:

- large enough for a worker to enter,
- limited or restricted means for entry or exit, and
- not designed for continuous worker occupancy.

What Are Some Examples of Confined Spaces?

- | | |
|------------------|---|
| • boilers | • storage bins |
| • furnaces | • hoppers |
| • sewers | • vaults |
| • septic tanks | • process vessels |
| • tunnels | • wells |
| • manholes | • pumping stations |
| • digesters | • water meter chambers |
| • piping systems | • open top spaces more than 4 feet deep |
| • tank cars | |
| • pits | |
| • diked areas | |
| • silos | |



Confined Spaces

What Are the Dangers of Confined Spaces?

Several hundred workers die in confined spaces each year. About 36% of those deaths are would-be rescuers.

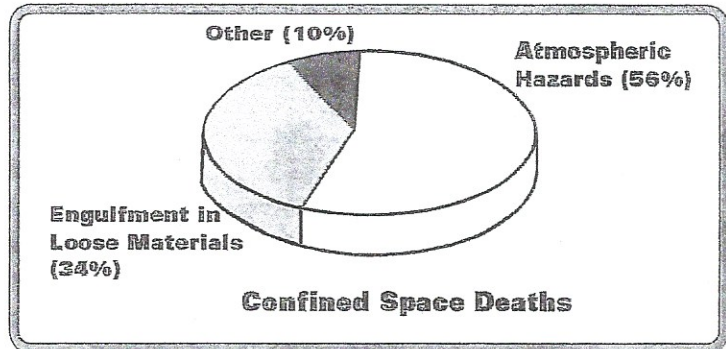
Confined spaces often contain hazards. A hazard in a confined space can be deadly. A hazard in a confined space could be an:

- atmospheric hazard
- engulfment hazard
- mechanical hazard
- other hazards

A recent NIOSH study found *atmospheric hazards* cause 56% of confined space deaths. *Engulfment* in loose materials causes 34%. *Other hazards* cause about 10%.

About 36% of confined space deaths are would-be rescuers.

If a confined space contains—or may contain—a hazard, your employer must take safeguards. In OSHA's General Industry Standards, a confined space with an actual or potential hazard is a permit-required confined space or PRCS. The OSHA Construction Standards do not use the term PRCS, but many of the same rules apply.



What Is an Atmospheric Hazard?

Atmospheric hazards may be:

- gases,
- vapors,
- dusts in the air,
- oxygen enrichment, or
- lack of oxygen.

Atmospheric hazards in confined spaces are very serious.

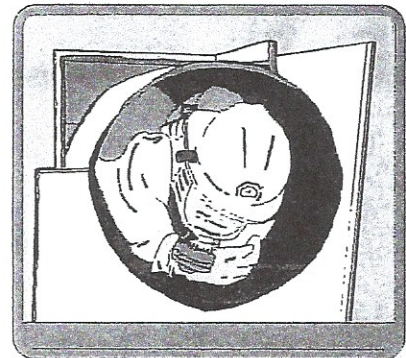
Atmospheric hazards can:

- suffocate you,
- poison you, or
- cause an explosion.



In confined spaces, there is virtually no air movement. Harmful build-ups of gases, vapors, or dusts

cannot disperse. Products you use without a problem in fresh air may be deadly in a confined space. For example, cleaning solvents.



In a confined space, the vapors from everyday products may build up to very high levels. This can make you ill or confused or even kill you.

Gases like carbon monoxide are odorless, colorless, and deadly.

Confined Spaces

Oxygen enrichment can happen when oxygen is added to a confined space.

Lack of oxygen can cause suffocation. Normal air contains about 21% oxygen. Even a non-toxic gas can displace the oxygen in confined spaces. This can reduce oxygen to below normal levels.

Also, if someone purges a confined space, it can reduce the amount of oxygen in the air.

If oxygen drops below 19.5% in air, it is an oxygen-deficient atmosphere. Above 23.5%, it

is an oxygen-enriched atmosphere. In either case, workers should not be in the area.

An explosion can happen in a confined space under one of these conditions:

- A flammable gas or vapor may be in the confined space.
- Airborne dusts may be present.
- In either of these conditions, a small spark, even static electricity from your clothes, can cause an explosion.

What Are Engulfment Hazards?

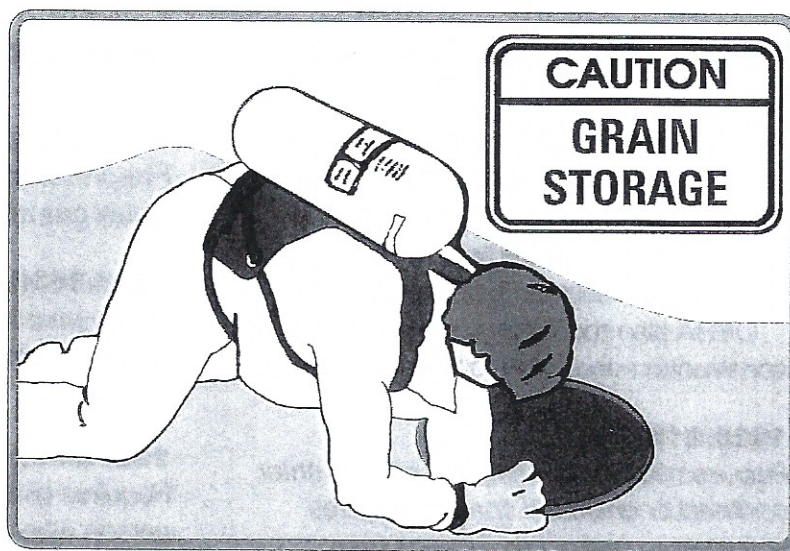
Engulfment can happen when there is a liquid or a 'flowable' solid in a confined space.

Water in a confined space may be a hazard if it rises too fast and you can't get out in time. Things like grain, starch powder, ore, coal, sawdust, or wood chips in a storage vessel can engulf you, too.

There may be pockets of air below the surface of a flowable solid that could give way when you step on it. If the materials trap you below the surface, you can suffocate due to the weight of the material.

The materials also will displace oxygen to suffocate you.

In the case of a grain elevator, fumigants can suffocate you.



Confined Spaces

What Are Some Other Hazards of a Confined Space?

Other hazards that may be in a confined space include:

- narrowing of space,
- corrosive chemicals,
- noise,
- electricity,
- poor lighting,
- extreme heat or extreme cold,
- falling objects,
- falls, or
- mechanical hazards.

Almost any of these hazards could keep you from escaping from a confined space.

For example, if the space narrows, you could move in too far and become wedged in the space.

Or, let's imagine you work alone in a confined space without an attendant. Let's say the chemical you use is corrosive. It could get into your eyes, blinding you. Then you would not be able to get out of the space.

Likewise, a falling object in the space could injure you so you could not get out.



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How Does OSHA Regulate Confined Spaces?

OSHA regulates confined spaces in non-construction settings under the General Industry Standard 29 CFR 1910.146.

Construction contractors must follow most of the requirements in this standard.

OSHA also regulates confined spaces in construction under the following standards:

1926.21(b)(6)(1)

Requires training for employees who enter confined or enclosed spaces; requires employer to protect employees from recognized hazards in confined spaces.

1926.21(b)(6)(II)

Defines the confined and enclosed places which require training.

1926.352(g)

Fire prevention measures associated with use of fuel gas and oxygen in confined spaces.

1926.353(b)(1)

Requirement for exhaust ventilation when welding, cutting, or heating in confined spaces.

1926.353(b)(2)

Requires airlines respirators and a standby person whenever the means of access is blocked by ventilation equipment.

OSHA General Duty Clause requires an employer to provide a safe and healthful workplace free from recognized hazards.

Confined Spaces

29 CFR 1926.21(b)(6)(i) requires the employer to protect workers from *recognized hazards* in confined spaces.

This protection would be assured if a construction contractor followed all provisions of the General Industry Standard.

An OSHA Compliance Officer cannot cite the construction contractor under the General Industry Standard. However, if there is a *recognized hazard* that the contractor fails to eliminate or control, OSHA may cite the contractor under the Construction Standards or under the General Duty Clause.

What Are the Differences Between Construction and General Industry?

Your employer must provide a workplace free of recognized hazards. This is true in both General Industry and Construction. This means the *same level of protection* must be given to workers at a construction site as to workers in a general industry setting.

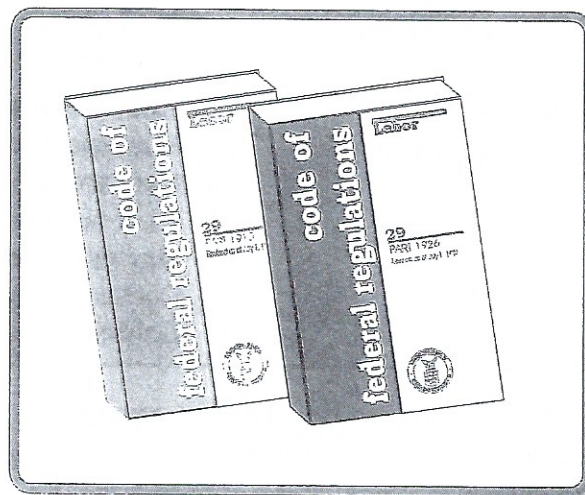
OSHA considers routine preventive maintenance in confined spaces to fall under the General Industry Standard. Some work that *you* may do under the General Industry Standard includes:

- relining a furnace with refractory bricks
- tuck pointing and individual brick replacement in a manhole
- repainting as part of a scheduled program to maintain a system or prevent its deterioration
- relining of a sewer line using a sleeve pushed through a section of the existing section

In these cases, your contractor must comply with the General Industry Standard. OSHA requires two things in General Industry that are not required in Construction. These are a *written program* and the *Entry Permit*. OSHA considers new construction to fall under the Construction Standard, including:

- reconfiguring a confined space
- installing new equipment

In this case, your contractor must comply with the Construction Standard.



Confined Spaces

Who Is Responsible for Safe Work in a Confined Space?

On a construction site, your contractor may build a confined space as part of new construction. There, your *contractor* is responsible for ensuring the work is done safely. Your contractor must comply with the Construction Standards on confined spaces and with the General Duty Clause.

Or, another company may hire your contractor to do confined space work on an existing site. Then that company is the *host employer*. The *host employer* must tell your contractor about all of the confined spaces, the hazards, and the precautions.

Situation	Responsible Party
Construction Site (New Construction)	Construction Contractor Must comply with Construction Standards and with General Duty Clause
Existing Site (Modify Space)	Host Employer (Owner) Must inform contractor of hazards, precautions. Must answer questions. Must discuss entry with contractor. May require use of company entry program. Contractor must train you in Host program. Contractor responsible for safety.

The *host employer* must have someone available to answer your contractor's questions.

The *host employer* must discuss the entry with your contractor to find out if there were problems with the entry program or any unexpected or uncontrolled hazards discovered during the entry.

The *host employer* may ask your contractor

to use its confined space entry program. This means you would follow the host company's rules.

Your contractor must train you in the *host company's* procedures.

Your contractor may also wish to follow his or her own confined space program. If so, it must be at least as protective for the workers as the *host employer's*.

What Do OSHA's Requirements Mean on the Job?

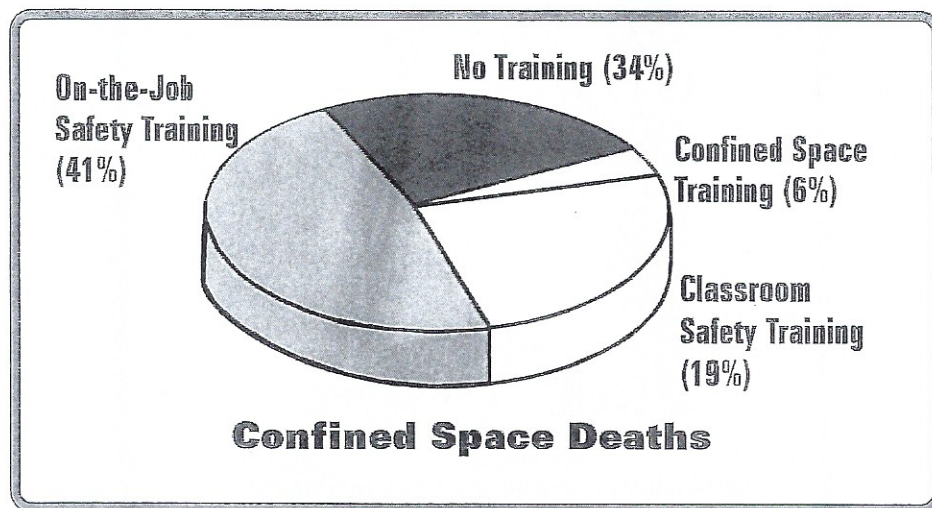
A NIOSH study of confined space deaths found that 34% of workers killed in confined spaces had *no training*. About 41% of those killed had received only *on-the-job safety training*. Only 19% of those killed had received *classroom training*. A tiny 6% of those killed had received *hands-on confined space training*. So, 75% of those killed had no training or on-the-job training.

75% of those killed had only on-the-job training or no training. Classroom training greatly reduces your risk of dying in a confined space. Hands-on training reduces it more.

If you work in a confined space, OSHA requires your contractor to *train* you **before** you do the work.

You can be trained to four general levels:

- entrant,
- attendant,
- entry supervisor, or
- rescue team.

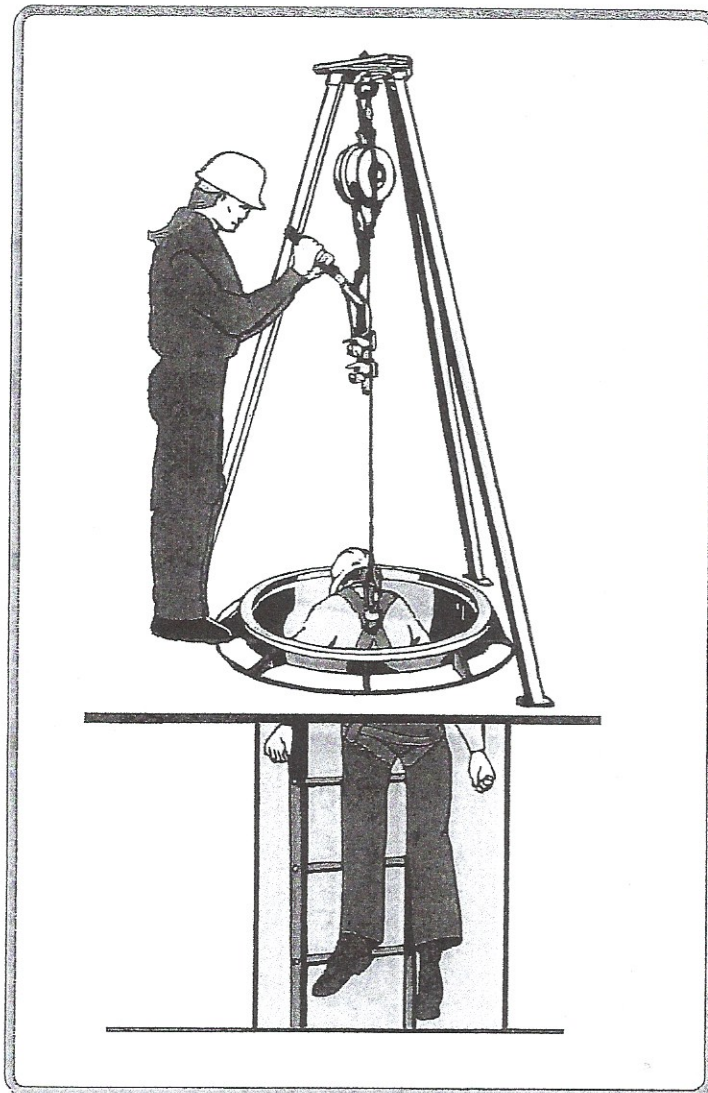


Confined Spaces

What Is an Authorized Entrant?

If your employer trains you to be an *authorized entrant*, your duties would include:

- Know the hazards you may face during entry—including symptoms, signs, and consequences of exposure.
- Properly use all required personal protective equipment.
- Communicate with the attendant as necessary to enable the attendant to monitor your status and alert entrants of any need to evacuate.
- Alert the attendant whenever you detect any warning sign or symptom of exposure to a dangerous situation or prohibited condition.
- Exit from the space as quickly as possible when the attendant tells you to do so, when you recognize any warning sign, when you detect a prohibited condition, or when you hear the evacuation alarm.



Your employer must train you.

What Is an Attendant?

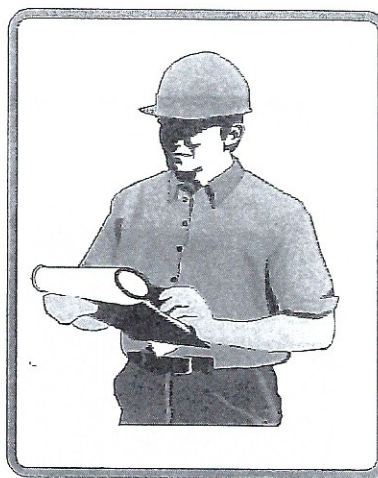
If your employer trains you to be an *attendant*, your duties would include:

- Know the hazards that may be faced during entry.
- Know possible behavioral effects of the hazards.
- Continuously maintain accurate count of entrants.
- Remain outside space during entry operations until relieved.
- Communicate with entrants to monitor their status and alert them of need to evacuate.
- Monitor activities inside and outside of space.
- Summon rescue and emergency services when necessary.
- Warn unauthorized persons to stay away.
- Perform non-entry rescues per employer's procedure.
- Perform no duties that interfere with your primary duty to monitor entrants.

What Is an Entry Supervisor?

If your employer trains you to be an *entry supervisor*, your duties would include:

- The entry supervisor has overall responsibility for the entry.
- Know the hazards that may be faced during entry.
- Verify that acceptable conditions for entry exist.
- Terminate entry when prohibited condition arises.
- Verify that rescue services are available.
- Remove unauthorized persons who enter or attempt to enter during the entry operations.
- Determine that acceptable entry conditions are maintained.

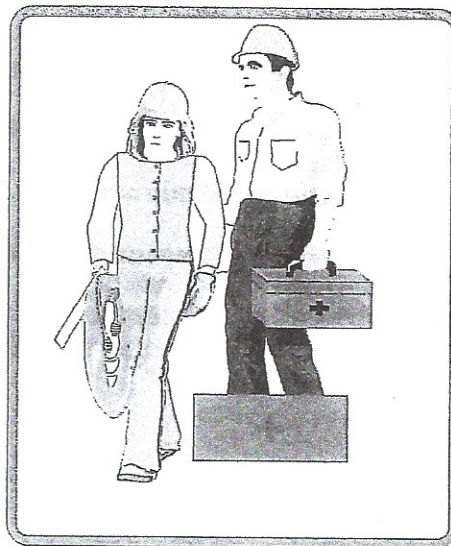


Confined Spaces

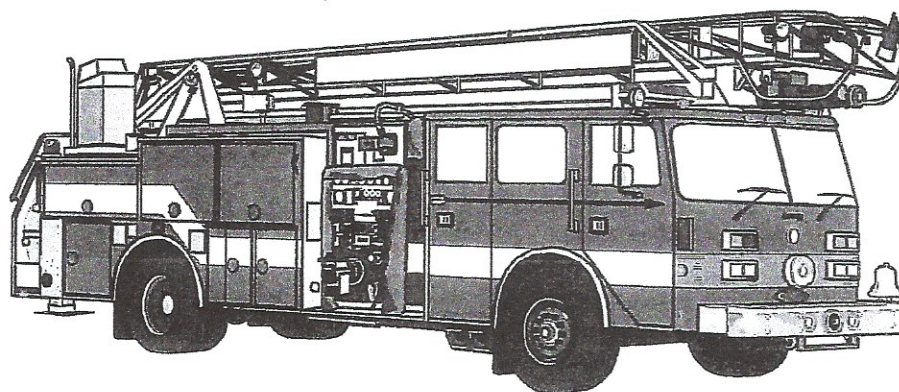
What Is a Rescue Team?

If your employer trains you to be a *rescue team* member, your duties would include:

- Properly trained in procedures and PPE use.
- Practiced rescues at least annually from similar space.
- Trained in basic first aid and CPR, one currently certified.
- Use retrieval equipment, if it does not increase hazard.
- Your contractor may choose to use an offsite rescue team. For example, the local fire department—but they must be properly trained and equipped.



Your employer must train you.



What Is an Entry Permit?

An *entry permit* is a kind of license that allows a confined space entry to happen. You may work at times under the General Industry Standards. So your employer must train you about the *entry permit system*. The *entry permit system* is not required in Construction. Briefly, the *entry permit* reminds workers what is needed for safe entry into a confined space. It lists the following:

- the confined space to be entered;
- purpose of the entry;
- date and authorized duration of entry permit;
- names of authorized entrants;
- names of attendants;
- name and signature of the entry supervisor;
- any expected atmospheric, physical, mechanical, engulfment, entrapment, or other hazards;
- methods used to eliminate or control the hazards in the space;
- the acceptable entry conditions;
- air monitoring results with the initials or signature of the tester;
- rescue service to be used, how to contact them;
- communication procedures for the attendant and the entrant;
- all special equipment and procedures, including personal protective equipment and rescue equipment;
- any other information needed for safe entry, and
- any additional permits needed, such as for hot work.

Confined Spaces

What About Air Monitoring Before and During Entry?

Before entry, *air monitoring* is done for the possible hazards in a confined space. At a minimum, your contractor will normally monitor for oxygen levels, explosive gases, and toxic gases. The toxic gases often monitored for include carbon monoxide and hydrogen sulfide. Some confined spaces must be monitored for more gases prior to entry. These will be determined by your contractor.

The table shows allowable concentrations of the three most common atmospheric hazards in confined spaces.

The LEL is the *lower explosive limit*. If the concentration of a chemical in air is below its LEL, the mixture does not have enough fuel to burn. The LEL is given in percents. Each percent is equal to 10,000 parts per million (ppm).

PPM means *parts per million*. PPM is a measure of concentrations of gases or vapors in air. As a fraction, one ppm is one one-millionth. This is a very small amount of material. Many chemicals have exposure limits between 10 and 1,000 parts per million.

PEL means *permissible exposure level*. The PEL is the airborne concentration of a chemical to which workers may be legally exposed day after day for a lifetime. PELs are set by OSHA.

IDLH means *immediately dangerous to life or health*. The definition usually refers to concentrations at which chemicals will kill or impair a person exposed for 30 minutes or less.

The gases must be tested for in a specific order. The tester must first determine the amount of oxygen in the air, then the amount of flammable gas, then the toxic gas.

Always look for oxygen first because if the oxygen level is outside of the acceptable range, then the LEL reading may be wrong on the meter.

There are hundreds of monitors available for this kind of air testing. If you are asked to use one, you must be trained in its use.

Allowable Concentrations of Gases in Confined Spaces

Gas Tested For	Allowable
oxygen	19.5% - 23.5%
LEL	less than 10%
carbon monoxide	less than 50 ppm

Test yourself on this brief review:

1. About 36% percent of confined space deaths are ?
 - a. painters
 - b. would-be rescuers
 - c. farm workers
 - d. fire fighters
2. Which of these possible confined space conditions is not an explosion hazard?
 - a. a flammable vapor
 - b. 20% oxygen
 - c. airborne dusts
 - d. 24% oxygen
3. Lack of oxygen can cause:
 - a. suffocation
 - b. dermatitis
 - c. nose bleed
 - d. hearing loss
4. Engulfment can happen in a confined space containing:
 - a. 24% oxygen
 - b. a flowable solid
 - c. a flammable vapor
 - d. 20% oxygen

Test yourself on this brief review:

1. If a construction contractor is hired to build a new confined space on an existing industrial site, which OSHA standards apply?
 - a. General Industry Standards
 - b. Construction Industry Standards
 - c. General Industry & Construction Standards
 - d. Host Employer Standards
2. Before a worker can enter a confined space, OSHA requires the employer to provide:
 - a. training
 - b. insurance
 - c. hazardous duty pay
 - d. overtime
3. If a worker is in a confined space doing repainting as part of a scheduled program to maintain a system, which OSHA standards apply:
 - a. General Industry Standards
 - b. Construction Industry Standards
 - c. General Industry & Construction Standards
 - d. Host Employer Standards
4. The four levels of confined space training required by OSHA are:
 - a. attendant, entry supervisor, entry manager, observer
 - b. attendant, entrant, entry supervisor, observer
 - c. entrant, attendant, entry supervisor, rescue team
 - d. entrant, attendant, entry supervisor, backup team

Confined Spaces

Case Study: What Went Wrong?

Following are the actual circumstances of a confined space death investigated by NIOSH.

The victim and two other workers were planning to install a sewer line from a building to the main sewer line in the street at a construction site. The sewer vault was entered through a manhole in the middle of the street. The manhole was 2 feet in diameter and 15 feet deep. In an effort to measure the length of the sewer line snub, the victim entered the manhole and descended a fixed ladder to the bottom. The sewer line snub extended from the vault, 15 feet toward the construction site.

Upon reaching the bottom of the sewer the victim complained of a strong odor and then passed out. The other two workers entered the manhole in an attempt to rescue the

victim. However, before they could reach the victim, they both became dizzy and exited the manhole. Several unsuccessful rescue attempts delayed notification of the fire department rescue squad for approximately 20 minutes.

The rescue squad arrived in 5 minutes. Rescue squad personnel entered the sewer using self-contained breathing apparatus, lifelines, and other personal protective equipment. The victim was removed approximately 8 minutes after the arrival of the rescue squad. Attempts to resuscitate the victim were unsuccessful. The victim was then transported to the local hospital where he was pronounced dead. The cause of death was asphyxia due to oxygen deficiency.

What Should Have Been Done to Prevent It?