

## CONTROLLING CONFINED SPACE HAZARDS WITH POLICY & PERMITS

By Joseph Knickerbocker and Hayden Manwaring

**A confined space is a space that is not designed for continuous human occupancy, is large enough to enter, and has limited access or egress, which means one must use a ladder or step over or duck under an obstruction or obstacle to enter or exit.**

**Confined spaces** may be located above us (e.g., ductwork), beside us (e.g., aboveground tanks, silos and equipment) or below us (e.g., belowground tanks, some utility tunnels and vaults). Found in various industries such as construction, agriculture, utilities, manufacturing, maritime, transportation, oil and gas extraction, and chemical processing, confined spaces magnify

### HAZARD CONTROL FOR CONFINED SPACES

#### •Stop and verify before entry.

Never enter a confined space without proper authorization, training and completed documentation; workers should pause work and contact a supervisor if they suspect confined space entry is required.

#### •Test and control the atmosphere.

Use atmospheric monitors to check oxygen levels and hazardous gases before entry and during confined space occupancy. Immediately evacuate if alarms sound or conditions become unsafe.

•Use ventilation and exhaust effectively. Maintain breathable air with properly designed ventilation systems and local exhaust controls, especially when work generates fumes, dust or chemical vapors.

•Lock out all hazardous energy and materials. Isolate and lock out machinery, valves, pipes and other energy sources to prevent engulfment, equipment movement or unexpected releases while workers are inside the space.

•Plan for rescue before work begins. Establish a documented rescue and emergency response plan, ensure that attendants and rescue personnel are trained, and keep rescue equipment ready at the entry point.

•Complete a thorough pre-entry assessment. Conduct a competent-person evaluation of every confined space to identify hazards; determine whether a permit is required; and document controls, communication methods and safe entry procedures.

even seemingly small hazards. For example, what if a worker were in a confined space and it started filling up with soil, sand, grain, water, steam or harmful chemicals? What if they have gained a significant volume of muscle mass, but the space that they are required to work in does not accommodate their build? What if equipment is not locked out properly and begins to operate, reboot or shift? What if the lights go out? What if the space is extremely hot? Workers in confined spaces face risks such as being buried alive, becoming physically stuck, dismemberment, entrapment, heat stress or illness, and other potential injuries.

If workers must operate in a space that is not intended for continuous human occupancy, is large enough to enter and has limited access and egress, they need additional training and potentially specialized equipment. Employers should instruct employees to stop and reach out to their supervisor for further instruction if they think they must enter a confined space to complete their work; their life may depend on it.

### Common Hazards

Confined spaces could asphyxiate, engulf, trap or expose workers to extremes that could be deadly. Hazardous atmospheres; engulfment; entrapment; moving equipment or machinery; slips, trips and falls; poor visibility; temperature extremes; loud noise; and risk of drowning are some of the confined space hazards discussed in this article.

Federal regulations in the U.S. require employers to establish a confined space policy that includes a pre-evaluation checklist to be performed on all confined spaces and a permit process for permit-required access (29 CFR 1910.146). Employers must ensure that every worker understands that they should never enter a confined space unless they have appropriate documentation and are trained and authorized to do so. Confined spaces can turn hazards from minor to life-threatening in seconds. This article discusses confined space hazards and

how to control them using a confined space policy and permit.

### Hazardous Atmospheres

The air we breathe is made up of roughly 21% oxygen, 78% nitrogen and 1% other gases. Inside confined spaces, atmospheres become hazardous when oxygen levels drop below 19.5% (oxygen deficient) or rise above 23% [oxygen enriched; 29 CFR 1910.146(b)]. In an oxygen-deficient atmosphere, the human brain does not get enough oxygen to sustain life. In an oxygen-rich environment, the oxygen itself can become explosive. Other harmful gases such as hydrogen sulfide and carbon monoxide can displace oxygen and poison those exposed. These gases can be measured by an atmospheric testing device. Many monitors are available on the market, and most help assess air quality by monitoring for explosive atmospheres, oxygen, carbon monoxide and hydrogen sulfide. The potential for exposure to a unique fume, chemical or gas not covered by these four common atmospheric exposures may require the addition of custom sensors or monitors.

Atmospheric monitors are typically set to alarm when gases reach action levels (the level at which it is no longer safe for workers to be exposed for a full 8 hours and therefore must be addressed). If workers are in a confined space and their monitor alarm activates, they should immediately exit and reassess their controls. For example, adding ventilation or exhaust fans may be an effective method for maintaining safe atmospheres.

Ventilation takes breathable air from outside of the confined space and forces it in. Things to consider while setting up a ventilation system include:

- how large the space is,
- what type of work will be performed,
- where inside the space the work will be performed,
- whether ventilation will be used to make an atmosphere nonhazardous or to keep it from becoming hazardous, and
- the type of chemicals being used.

If the work being performed will bring in chemicals or create fumes or dust inside a confined space, adding ventilation may not be enough to maintain a safe and productive atmosphere. Exhaust may also be required. For the exhaust to be effective, it must be close enough to the source of the hazard to capture it. Wearing a filtering face mask does not provide oxygen. If ventilation cannot be maintained and work must be performed in an oxygen-deficient atmosphere, air respirators must be supplied.

### Engulfment

Engulfment occurs when a substance such as water, chemicals, steam, soil, sand or any other granular material surrounds or buries an employee. Controls for this type of hazard include protective systems such as trench boxes or shoring of excavations deeper than 5 ft (29 CFR 19126.652). Lock out sources for all substances that could engulf an employee, including locking out multiple sources if necessary. Missing just one can mean the difference between a safe workday and an engulfed worker.

Humans can drown in as little as a few inches of water. Ensure that liquids are removed from confined spaces or other accommodations are in place to protect workers from drowning hazards. Prior to entry, lock out valves and blank off pipes where possible that could fill the space with water or other liquids.

### Entrapment

Some confined spaces have configurations that can easily entrap an employee such as silos with inward-sloping floors or equipment enclosures where people may get stuck. For example, workers could be entrapped while stripping formwork inside a concrete vault. Ensure that systems emphasize choosing wisely when deciding who will enter a tight space.

### Moving Equipment or Machinery

Workers may be required to enter a space that has moving parts, machinery or other equipment such as a trench or a trash compactor. If they are bringing in the moving equipment, ensure that they have adequate space to avoid pinch points. If the space itself has moving parts, control them with effective lockout/tagout, restraining all moving parts and verifying a zero-energy state before entering.

### Slips, Trips & Falls

If a worker slips and falls on the ground, others can often easily get to



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them to provide needed assistance. However, if a worker slips and falls in a confined space, access for emergency responders is limited and this could result in delayed care and even more serious consequences. Falls from heights inside or into confined spaces, even when using personal fall arrest systems, limits rescue and care options. Always have a rescue plan when a personal fall arrest system is required. Access points also must be addressed. One hazard for slips, trips and falls that can be overlooked is the hole created when a manhole is opened. Always protect holes and set up ladders or scaffold where needed to accommodate not just access and egress but a quick and safe response when rescue is required. For many confined spaces, access is accomplished by crawling in, using a ladder or being lowered into the space; in such cases, the hole attendant is key to the worker's exit.

### Temperature Extremes

Confined spaces in the ground often have moderate temperatures. However, a confined space can become oven-like when exposed to high heat such as from a boiler room or direct sunlight. PPE such as HazMat suits or chemical protective gear can also make conditions hotter for workers. Ensure that workers are drinking plenty of electrolyte-rich fluids. Take appropriate breaks to monitor and maintain an entrant's core body temperature. Long exposure to extreme temperatures can

cause core body temperatures to rise or fall. A change of 6 °F to a person's core temperature can cause hypothermia or heat stress. While it is less common for confined spaces to have excessive cold temperatures, the remedies for both extremes are similar. Maintain good hydration and ample airflow, encourage needed breaks and always have an attendant standing by.

### Poor Visibility

Poor lighting can increase slip, trip and fall hazards while simultaneously decreasing ability to perform quality work. Conditions in confined spaces can limit lighting options. Depending on the space, workers may need explosion-proof lighting. The ability to see well can also be affected by dust or smoke from activities such as welding or sandblasting. In these situations, adding light does not help as much as controlling the dust or smoke at its source. Use water delivery systems or vacuums to control silica dust and evacuate other dust or smoke with a local exhaust system.

### Noise

High noise levels inside confined spaces may be generated by work activities within or outside these spaces. Sound waves in a confined space are often amplified, which can adversely affect worker hearing. If the noise inside a confined space is higher than the OSHA-required action level of 85 dBA, then hearing protection must be used (29 CFR 1910.95(c)(2)). The higher the

noise levels, the higher the protection requirements. Permissible exposure limits and time-weighted averages must be monitored and calculated to ensure that controls are sufficient.

## Confined Space Policy

Because confined spaces can magnify even the smallest hazards, employers who expose employees to confined spaces are required to establish a confined space policy that includes space evaluation and may require a permit program (29 CFR 1910.146).

## Pre-Assessment Checklist

Every confined space requires a pre-assessment, which documents the determination of whether a permit is required for access. Many employers create pre-assessment checklists to ensure consistent evaluations. Pre-assessments should always be performed by a competent person, defined as one who is capable of identifying existing and predictable hazards and has authorization to take prompt corrective measures to eliminate them [29 CFR 1926.32(f)]. When performing a pre-assessment, start by documenting the confined space details and planned work to be performed. This pre-assessment can be broken down into three major parts.

In part one, document whether the space in question is a confined space by confirming three statements:

- 1) It is not designed for continuous occupancy.
- 2) A human body can fit into the space.
- 3) The area has restricted means of access and egress.

If all three statements are not true, then the assessed space is not a confined space and the assessment is complete. If all three statements are true, it is a confined space and assessment should continue.

Part two determines whether a permit is required. This is where all anticipated hazards are documented. Having a pre-determined list of common hazards and hazard-generating activities on a checklist can be helpful.

In part three, document the planned entry procedure. This section could include determination options such as permit required, no permit required or alternate entry required (which may allow for entry without a permit if certain controls are maintained). If a confined space is determined to be permit-required, then it must be labeled

as such, and the signage must be maintained at all times for the duration the site is active (29 CFR 1910.146; 29 CFR 1926.1203). Even if a permit is not required, it may still be good practice to complete it and use it as a guide for safe entry, work and egress.

## Permit

If an employer has permit-required confined spaces that their employees may be exposed to or required to work in, they need a permit as part of their confined space program (Appendix D of 29 CFR 1910.146 offers an example of an entry permit). While permits come in many different formats, each permit should include:

•**General information (e.g., confined space identification, involved personnel and purpose for entry).** This is the what, why and who section. Permits should identify what space, why it is being entered and who is involved (e.g., entry supervisor, trained rescue personnel, entrants, attendants). Additional information regarding roles, responsibilities and training requirements for each of these can be found in 29 CFR 1910.146.

•**Hazard assessment and controls.** This section addresses the anticipated hazards and documents the safety controls that will be put in place and maintained throughout the active permit. This may include checklists and monitoring logs. Communication methods should be documented here as well. Determine the best communication method for the space. This could be visual, voice, by phone or radio.

•**Emergency and rescue plan.** All involved must be trained on the emergency action plan prior to the entry. Supervisors must ensure that all needed rescue equipment is in place and operational.

•**Validation and endorsements.** Signature blocks indicate the required signatures for the permit to become active. Entry of a permit-required confined space must not occur until after this permit is fully completed and signed. On most active sites, supervisors are required to notify plant management any time someone enters a confined space and when the work is complete.

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All supporting documentation involved in the entry should remain at the entry point during the operation.

## Conclusion

A confined space is a space with limited access or egress, is not designed for continuous human occupancy, and is large enough to enter. Confined spaces can turn moderate to minor hazards into deadly situations such as hazardous atmospheres; engulfment; entrapment; moving equipment or machinery; slips, trips and falls; falls from heights; temperature extremes; poor visibility and high noise. Implementing a confined space policy can help document, identify and eliminate most of these hazards and control those that remain. The policy helps ensure that all confined space entry activities are performed in a safe manner, from entry to exit. EHS professionals must care enough to never enter a confined space or allow others to do so unless proper documentation is in place and entrants are trained and authorized. **PSJ**

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