Confined Spaces, Health Risks, and Worker Safety

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The Safety Company

Is it a confined space? These examples may not immediately meet the eye.
Confined spaces exist in many forms and are found in industry, food, chemical and petroleum processing, utility and communications installations, construction sites, and other work areas. It's best to treat unknown areas and their interior environments as if confined space exists and to take all necessary safety precautions.

Confined space entry presents potential hazards if conditions are not checked in advance or if proper PPE is not worn. Confined space entry ports and shafts are often small and narrow, accessed via ladder or rope. If hazardous conditions exist within, workers can be trapped inside and become subject to toxic gases, explosions, oxygen deficiency, particulates, and other hazards.

A confined space:

- is an area large enough for an employee to bodily enter and perform work.
- has limited or restricted means of entry or exit.
- is not designed for continuous human occupancy.

A permit-required confined space has one or more of the following characteristics:

- it contains, or has a known potential to contain, a hazardous atmosphere.
- it contains material with engulfment potential.
- it is configured such that entrants could be trapped or asphyxiated by inwardly converging walls or floors that slope and taper to a smaller cross section.
- it contains any other recognized serious safety or health hazard.

Many employers develop written safety procedures, provide training, and work with the Occupational Safety and Health Administration (OSHA) regarding confined space atmospheric testing and use of respiratory, fall protection, head, eye, and face, hazmat, and gas detection gear. Injuries and fatalities do occur; reasons range from employers having no confined space procedures in place or not implementing their own programs, to workers ignoring documented hazards, procedures, and company-provided personal protective equipment.

Confined spaces are sometimes deceptive in appearance. For example, the interior of an open-topped water tower is defined as a confined space, even though the top is open to the outdoor environment. This paper discusses lesser-known examples of confined spaces, many of which are on record as sources of injuries and fatalities.

Open-topped water tanks, such as those used to supply municipalities with fresh water, require maintenance involving priming, painting, refinishing, and sandblasting. Work is sometimes performed via catwalks located above or risers placed within tanks. As these processes require use of potentially hazardous materials such as epoxies, adequate ventilation, oxygen sensors, and PPE are often necessary. Otherwise, unprotected workers within such tanks may be subject to concentrated hazardous vapors plus lack of oxygen despite the tank's open top.

Maintenance workers at **natural gas well fracturing tanks** are potentially at risk if correct precautions are not taken. Tank entry without gas detection and personal PPE has resulted in worker death and injury from high exposure to methane vapors.

Recorded incidents related to sewer and underground pump station maintenance include flooded chambers, toxic gas leaks, and oxygen-deficient atmospheres, resulting in drowning and carbon monoxide/sewer gas/lack of oxygen asphyxiation. Newer self-priming sewer pumps help to offset these incidents as they minimize worker proximity when wet wells are manually pumped out below pump intake levels.

Sewer and trench hazards involve migration of carbon monoxide (CO) through soil layers following the use of explosives to enable pipe and manhole installations. Explosions used to break up rock layers can cause carbon monoxide release in high concentrations. Workers descending into pits without adequate ventilation and too soon after explosions occur are subject to potentially fatal CO levels.

Control valve pits for water fountain displays pose potential asphyxiation hazards, as workers must crawl inside these pits to perform valve adjustments and maintenance. Workers can be subject to carbon monoxide buildup due to sewer trap gases found within, or oxygen deficiency/displacement due to mechanical corrosion or vegetation decomposition.

Waste water holding tank maintenance may involve use of sulfuric acid used for drain cleaning. Toxic acid vapors plus possible methane gas produced by stored waste provide a significant confined space entry hazard for both toxic chemical exposure and asphyxiation.

Degreasing tanks are used in various industries to clean metal parts. Occasionally these tanks must be cleaned, potentially subjecting workers to vapors from solvents used in the degreasing process. Generally, solvents, which can have poor warning properties, are drained and either discarded or stored for later use. Entry should be attempted only after the confined space has been thoroughly ventilated. Without air quality monitoring and PPE, workers are potentially at risk for high toxic chemical exposure.

Grain silos present several confined space entry challenges. One such scenario involves ***bridging***, a condition where stored wet grain crusts at the silo's surface, slowing grain flow. Workers sometimes walk on this surface to break up crust. Workers attempting to break up crusted grain in this fashion have fallen through and died from engulfment.

Flowing grain emptying through a silo's bottom creates a surprising degree of force. A worker who has slipped into the grain flow just waist deep is at considerable suffocation risk even when clutching a safety rope.

Grain spoilage presents yet another worker confined space hazard, as decomposition produces carbon dioxide, displacing oxygen within the silo. Workers within have been known to suffocate from lack of oxygen at the grain surface.

Sawmills store **sawdust in silos** to keep on hand as a fuel source. Sawdust can be burned to heat water to generate steam heat, converted to electricity for mill use. Sawdust is moved from silos using sweep auger advance mechanisms that are subject to clogging during the removal process. Workers attempting to clear auger clogs can be subject to sawdust engulfment and death via asphyxiation. In light of this confined space hazard, some storage facilities have retrofitted silos with mechanical devices, minimizing the need for worker entry.

Steel mills employ **electric arc furnaces** and turret-mounted ladles for molten steel component blending. This process uses piped-in argon to aid in the blend. Turrets are driven by gears and motors housed below in confined service areas. Argon leakage may find its way inside these small areas, posing a hazard to ill-prepared entrants. Argon displaces oxygen, leaving those within a confined area of argon leakage at great risk for harm from oxygen deficiency. Fatal incidents have caused some mills to reroute argon piping away from these confined service areas.

Cleaning, repair, and refurbishment of **railroad tank cars** can put workers at risk of asphyxiation or engulfment, as this line of work often involves interior sweeping, welding, cutting, scraping, buffing, and abrasive blasting. Workers may be subjected to hazardous tank residue of transported toxic chemicals, airborne insulation, and dust. ***Cover gas*** such as nitrogen may be used to inert interiors, preventing spoilage of food-related shipments but displacing the remaining oxygen within. Polyisocyanate foam used to insulate chlorine-carrying tank cars is a source of potential ignition, the smoke from which may expose workers to toxic substances.

Workers generally enter empty tank cars via top hatches. It is essential that railroad tank cars and other transport tanks are properly marked with warning signage and tags. Tank car interior confined spaces should be adequately ventilated as well as sampled and monitored for toxic gases, particulates, and oxygen deficiency.

Conclusion

Confined spaces represent potentially major health and safety risks for many workers. The ability to recognize and plan appropriately for confined space work can mean the difference between a job well done and disaster.

For full compliance with the OSHA standard that governs confined spaces, 29 CFR 1910.146, it is necessary to rely on the expertise of safety and health professionals such as industrial hygienists. MSA, with over 90 years of industrial safety experience, can assist in this effort by providing equipment, training, and services suitable for the special conditions found in confined spaces.

References and sources:

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