# Confined Space Safety
# Part I—Entry Hazards and Controls

The hazards of confined spaces must be fully understood by employees, management and others in winery businesses. This need is unfortunately demonstrated by the high number of fatalities involving confined space entry, many of them involving multiple employees. According to the Bureau of Labor Statistics (BLS), an average of 92 fatalities occurred annually between 1998 and 2000. The National Institute of Occupational Safety and Health (NIOSH) estimates that over half were employees attempting to rescue injured co-workers.

Lack of knowledge and poor understanding of the hazards and controls are primary factors in fatalities and injuries related to confined space entries. One NIOSH study notes that oxygen deficiency or hazardous atmospheres in confined spaces represent 75% of all incidents.

This Risk Management Bulletin reviews the common hazards and controls of confined spaces. Specific information on confined space entry and rescue programs is outlined in Risk Management Bulletin #154, ***Confined Space Safety, Entry and Rescue Programs***.

**What is a Confined Space?**
Confined spaces exist in almost all industries. Possible hazards include engulfment, entrapment and hazardous atmospheric conditions that would not normally occur in an open work area.



By definition, a **confined space** is:

- Large enough and configured so that a worker can enter and perform work, and
- Not designed for continuous worker occupancy, and
- A space with limited or restricted means of entry and exit.

Confined spaces in wineries may include:

- Fermentation tanks
- Presses
- Vats
- Pits
- Sumps
- Chemical storerooms
- Vessels

Confined spaces are further defined and classified as permit or non-permit required confined spaces.

### Permit Required Confined Space

Confined spaces that are classified as permit-requiring has **one or more** of the following characteristics:

- Contains (or has the potential to contain) a hazardous atmosphere.
- Contains any material that has potential for engulfment or entrapment of an entrant.
- Has inwardly converging/tapering walls or floors than can trap or asphyxiate an employee.
- Contains recognized serious safety/health hazards.

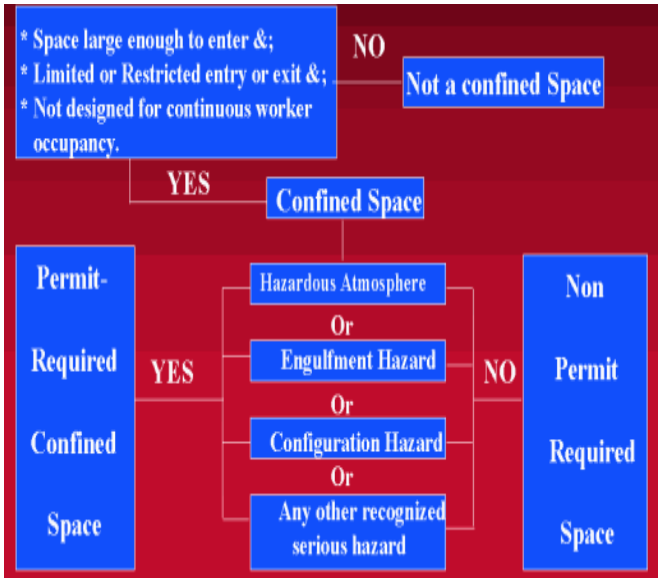
### Non-Permit Required Confined Space

Non-permit confined spaces have no actual or potential safety and health hazards capable of causing death or serious physical harm. This may

be due to the general characteristics of the space or elimination of any hazards. Additionally, there must be no actual or potential for atmospheric hazard. However, there must be documentation of this process. Further evaluation of this confined space must be completed if new hazards develop thus requiring a regular assessment of non-permit required confined spaces for the absence of safety and health hazards.

### Is a Permit Required?

A hazard assessment process must be completed to identify hazards or potential hazards that will adversely impact the safety and health of any employee entrant if not properly controlled. This flowchart describes the basic process in which this hazard assessment is completed.




## Confined Space Hazards and Controls

### Hazardous Atmospheres

Perhaps the most critical step of ensuring employee safety is to identify the hazards and then the effective controls prior to entering a confined space. For example, this knowledge is ignored when would-be rescuers rush to the aid of injured co-workers within a confined space.

The most common confined space hazard is the presence of a **hazardous atmosphere** in which the air is oxygen-deficient, oxygen-enriched, flammable and/or toxic. Gas meters must be utilized to analyze the atmosphere of the confined space prior to and during a confined space entry.

Some atmospheres may include levels of chemicals above occupational exposure limits (OELs), flammable limits, or immediately dangerous to life and health (IDLH) limits. At levels above the OEL, health effects may be noted, and levels above IDLH pose an immediate or delayed threat to life or the ability to escape unaided from the confined space. The Material Safety Data Sheet (MSDS) contains information that can guide you in identifying hazardous atmospheres.

- An **oxygen deficient** atmosphere contains less than 19.5 percent available oxygen. Chemical reactions due to the decomposition of organic matter (sewage) or certain chemical reactions (rusting) can reduce the available oxygen level.

- **Oxygen enriched** atmospheres caused by the introduction of pure oxygen as ventilation will act as an accelerant with combustible and flammable materials. Never use pure oxygen to ventilate a confined space. Safe working environments are characterized by an oxygen level between 19.5 and 23.5 percent.

- **Flammable atmospheres** occur due to the accumulation of flammable gases or vapors such as methane, propane and gasoline. A flammable atmosphere will occur only when certain concentrations of chemicals are present in the air. The lower flammable limit (LFL) is the leanest mixture of chemical in the

air that will ignite. The upper flammable limit (UFL) is the concentration that is too rich to burn. Between the LFL and UFL, a source of ignition (e.g., sparking tools) could ignite a combustible gas or liquid.

A space is considered to be a flammable atmosphere if the following exists.

- The flammable gas, vapor or mist level is at 10% or higher of the LFL, and
- The concentration of airborne combustible dusts meets or exceeds its LFL, and
- Any other atmospheric condition that is Immediately dangerous to life or health. (IDLH)

If the confined space is determined to contain a flammable substance, the area should be ventilated prior to entry. Non-sparking equipment or tools should be used.

- **Toxic atmospheres** can be created by substances from a variety of sources if they exceed the occupational exposure limits. (OEL) This may occur from activities taking place within a confined space such as spraying the interior of a vessel with protective sealant.

  Chemicals discarded into the sewer system or spills may create a toxic atmosphere. Sewer gases such as hydrogen sulfide pose a significant health risk as it is classified as a flammable gas as well as a broad spectrum poison. If combustion has occurred in a confined space, carbon monoxide may be generated as a by product. Carbon monoxide is a colorless and odorless gas.

  If atmospheric test reveals a toxic atmosphere, the space should be ventilated to remove the toxic substance. Retesting should be done to ensure removal is complete. If this is not possible, respiratory protection must be utilized. Keep in mind that the atmosphere may not only contain a contaminant that exceeds the OEL but also may contain a flammable gas or vapor with a oxygen concentration below 19.5%.

**Hot work** includes welding, cutting or brazing deserves discussion as it uses up oxygen and may create toxic by-products. These are also common tasks that are performed within confined spaces. Gas meters must be used to monitor the air so that the ventilation can be continually assessed for maintaining air contaminants below OELs.

If monitoring finds levels of chemicals above occupational exposure limits or oxygen deficient or enriched atmospheres, entry should not be attempted without an approved self-contained breathing apparatus (SCBA) or supplied air hose with an escape pack. Forced ventilation may be used as a method of control or elimination of the hazard but must be accompanied by atmospheric testing prior and during entry.

In wineries, the fermentation of products and maintenance activities can create various gases and other contaminants in hazardous concentrations high enough to be toxic or to displace oxygen and cause asphyxiation. Products of fermentation may include sulfur dioxide, carbon dioxide, carbon monoxide, and ethanol. Maintenance activities such as welding, repairing and cleaning of confined spaces can generate toxic metal fumes and/or displace oxygen.

## General/Physical Hazards

### Engulfment

Contents of bins and hoppers such as loose granular material (e.g., sand, grain or similar material) can engulf the employee leading to suffocation and crushing related injuries. Additional engulfment hazards are dense gases that may fill the lungs or a liquid that may lead to drowning of the employee or allowing the employee to be struck by moving objects. Typical engulfment hazard are cement, gravel, water and grain. Excavations can also be considered confined spaces.

## Temperature

Extreme temperatures may lead to injury or illness and at a minimum affect the performance of the employee. For example, a high ambient temperature accompanied by high humidity within a confined space may lead to heat related illnesses.

## Noise

If noisy equipment is used in a confined space, the noise may be amplified due to the design of the space. High noise levels can damage hearing and prevent effective communication between employees.

## Falling Objects

Employees in confined spaces must be mindful of work being done above the worker and in spaces that have topside openings. Tools, equipment and materials must be secured properly. Toe boards should be used on scaffolding or whenever practical at the top of openings.

## Configuration Hazard

Walls that taper in or floors that slope downward can trap or asphyxiate the entrant. Grain bins and hoppers are common examples.

## Slick/Wet Surfaces

Slip and falls can contribute to configuration related hazards and general concerns with employees falling in a confined space. Also, electrical shock is possible if moisture is involved in conjunction with electrical circuits, equipment and tools.

## Atmospheric Monitoring

Testing the atmosphere for oxygen content, flammable gases or vapors, and toxic chemicals is a necessary step for all permit required confined spaces to verify acceptable entry conditions. The monitoring should be done with a remote monitor on a wand attached to a calibrated gas meter to allow the employee to test from the outside of the confined space. A hazardous atmosphere may exist at more than one level in the confined space, therefore it is necessary to test the air at several levels in the confined space (e.g., top, middle, bottom). Keep in mind that the oxygen monitoring should be done first since the explosive gas monitor will not be accurate if there is an oxygen deficiency. **Never trust your senses to determine if the air in a confined space is safe for human occupancy.**

There are a variety of electronic gas detectors (i.e. multi-gas meter) that measure the following:

- Oxygen
- Flammable atmosphere
- Toxic chemicals (specific chemicals)

Gas detector tubes are less reliable while offering only a spot check. Entrants should use an electronic multi-gas meter when inside a confined space.

## Controls for Hazards

Specific controls have been discussed including some of the following strategies. The first priority is to eliminate the hazard. The best method is to avoid the need to enter the space. In wineries, options include providing long handled tools, automated cleaning systems, upgrading systems, or using outside contractors. *Other methods of e*liminating the hazard include purging, inerting, double block and bleed, continuous ventilation, lockout/tagout, blinding/blanking and flushing.

One must realize that an effective lockout/tagout program is a critical part of an effective confined space entry program. If the hazard cannot be eliminated then it can be controlled by applying additional controls such as forced air ventilation and the use of appropriate personal protective equipment.

*Jobs and tasks should be completed whenever possible with out entering the confined space . Confined space entry should be considered a last resort.*

## Personal Protective Equipment

Personal protective equipment is used to protect employees after all other feasible controls have been attempted to control a hazard. However, some personal protective equipment such as hard hats, eye protection, protective clothing, hearing protection, hand and foot protection should be utilized even if the hazard has been eliminated. In many situations however, the hazards have been only controlled rather than eliminated.

If it is not be possible to eliminate or control (below OEL) a hazard such as an airborne contaminant or an oxygen deficient environment, respiratory protection must be used. An assessment of the exposure must be conducted in order to select the appropriate respirator for the hazard. The selection and use of respirators must be carefully managed through a company's respiratory protection program.

## Rescue

A method of rescuing an entrant must be utilized during all permit confined space entries. This may include the use of a chest or full body harnesses with a retrieval line attached to the center of an entrant's back near shoulder level or above their heads unless the use of this equipment poses a greater hazard to the employee. A mechanical device must be available to retrieve someone from permit spaces more than five feet deep. If you do not have the training and equipment needed to perform a confined space rescue, you should know who you can call before you begin entry. Some local fire departments can perform this service. The response time for a rescue team must be adequately evaluated based on the confined space hazards. In some cases, the rescue team must be stationed at the confined space before entry.

## Communication System

Proper communication among entrants working inside a confined space and with those who are serving as attendants outside of the space is to critical to employee safety. Effective lines of communication allow attendants to easily communicate atmospheric changes to entrants and to monitor work inside of confined space.

Methods of communication may vary from confined space configuration to the task being performed. Options include: verbal, hand signals, intercom system, light signals, tapping codes, two-way radios and signaling through safety lines when other methods are not possible. All electronic equipment must be backed up by non-electronic systems and not pose an additional hazard such as an ignition source.

The variability of the hazards and the complexities of implementing effective controls underscores the importance of a written and fully implemented confined space entry program that addresses the following:

- Identification and evaluation of hazards
- Classification of confined spaces
- Duties of entrant, attendant and entry supervisor
- Procedures for entry, including work practices, atmospheric monitoring, and personal protective equipment
- Permits
- Training
- Rescue and emergency procedures
- Risk assessment/hazard recognition

These program elements are addressed in the Risk Management Bulletin #154, ***Confined Space Safety, Part II — Entry and Rescue Programs.***

For further information and assistance, contact your Zenith Safety and Health Consultant.