

# **CONFINED SPACE ENTRY TRAINING GUIDE**

Oakland University  
Office of Environmental Health and Safety  
Department of Purchasing and Risk Management

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## Confined Space Entry Training Guide

### What is a Confined Space?

A confined space is an area that: (OSHA Standard criteria indicated with an asterisk\*)

- has unfavorable natural ventilation or an atmosphere that could contain or produce dangerous air contaminants
- has limited or restricted means for entry and exit (i.e., smaller than a standard size doorway)\*
- is not designed for continuous employee occupancy\*
- is any open surface tank deeper than four feet
- is large enough and so configured than an employee can bodily enter and perform assigned work\*

Examples of Confined Spaces include:

Storage tanks	Pits	Boilers
Vessels	Vats	Furnaces
Manholes	Sewers	Ventilation/exhaust ducts
Degreasers	Tunnels	Silos

### What hazards do confined spaces present?

Contains or has the potential to contain ATMOSPHERIC hazards, including:

- The presence of flammable/explosive vapors, gases and/or liquids
- Oxygen Deficiency (less than 19.5% oxygen)
- Oxygen Enrichment (greater than 23.5% oxygen)
- Toxic vapors and/or gases

Contains a material (e.g. water, earth) that has the potential for ENGULFING an Entrant

Has an internal configuration such that an Entrant could be TRAPPED or ASPHYXIATED by inwardly converging walls or by a floor, which slopes downward and tapers to a smaller cross-section

Contains an other recognized NON-ATMOSPHERIC hazard (e.g. mechanical\*, electrical\*)

**\*THESE NON-ATMOSPHERIC HAZARDS ARE ADDRESSED VIA BREAKING, CAPPING, OR BLANKING LINES, AND/OR PROPER POWER LOCK-OUT PROCEDURES.**

## Confined Space Entry Training Guide

### What is a Permit-Required Confined Space?

A confined space by definition, that contains one or more of the following hazards: *ATMOSPHERIC*, *NON-ATMOSPHERIC* and /or the potential for an Entrant to become, *TRAPPED*, *ENGULFED* or *ASPHYXIATED*.

### What are the Air Monitoring Tests performed in a Confined Space Atmosphere?

The confined space atmosphere is tested for:

- The proper oxygen content (between 19.5 and 23.5% oxygen)
- The presence of flammable or explosive substances
- The presence of toxic gases and vapors

The University owns a *GasTech GX-86 Four Gas Monitor* which is stored at Central Heating Plant and is used to perform these tests. Specifically the instrument monitors for the following:

- **Proper Oxygen Content.** The Monitor will give an oxygen concentration reading between 1 and 100% The alarm will sound if the oxygen content of the atmosphere is at or below 19.5% or at or above 23.5%. **IMPORTANT:** Any alarm condition indicates further testing is required. If the oxygen reading is above the detection range of the oxygen sensor (40.0%), a steady alarm sounds and the oxygen reading is replaced by **OVER**.
- **Presence of Flammable/Combustible Gases or Vapors.** These are measured on a scale that measures from 0 to 100% LEL or lower explosive limit (also called LFL or lower flammable limit). The lower explosive limit is the smallest concentration of gas that will ignite IF an ignition source is present. The higher the reading on the combustible gas scale, the greater the danger of explosion. At 10 % LEL the first (low) level alarm, a pulsed tone, will sound and the COMB LED flashes. At 50% LEL the second (high) level alarm, both tone and LED are continuous. If the reading is above the detection range (100% LEL for most applications), a steady alarm sounds and the combustible gas reading is replaced by **OVER**.
- **Presence of Hydrogen Sulfide.** This gas is measured in terms of the number of "parts of contaminants in a million parts of air," otherwise referred to as "parts per million," or simply "ppm." There are different "safe" levels for different contaminants. Some are unsafe with only a small fraction of 1 ppm; the safe levels for others may be up to a thousand ppms. The OSHA 8-hour PEL (or permissible exposure limit) for hydrogen sulfide is 10 ppm. The low level alarm, a pulsed tone, and the H2S LED flashes at 10.0 ppm. At 30.0 ppm, the high level alarm, both the tone and H2S LED are continuous. If the H2S reading is above the detection range of the sensor (100 PPM), a steady alarm sounds and HxS reading is replaced by **OVER**.
- **Presence of Carbon Monoxide.** This gas is also measured in terms of the number of "parts of contaminants in a million parts of air," or ppm. The OSHA 8-hour PEL for carbon monoxide is 25 ppm. At the low level alarm setting of 25.0 ppm, a pulsed tone sounds and the CO LED flashes. At the high level alarm setting of 100.0 ppm, the alarm tone and LED are continuous. If the CO reading is above the detection range of the sensor (300 PPM), a steady alarm sounds and the CO reading is replaced by **OVER**.

## Confined Space Entry Training Guide

### How are the INITIAL Air Monitoring Tests Performed?

- **MAKE CERTAIN THE EQUIPMENT HAS BEEN CALIBRATED CORRECTLY!**
- Testing is first done from OUTSIDE the confined space. With regard to a manhole, it is often a good idea to use the air monitor to "sniff" around the manhole cover BEFORE LIFTING THE COVER, since lifting the cover can often cause sparks, that could in turn ignite any flammable gases around the perimeter of the manhole.
- Once the space has been opened, the extender cable connected to the Air Monitor is placed or lowered inside the confined space. Because certain dangerous vapors and gases are heavier or lighter than air, tests must be conducted at different levels within the space also known as testing stratified atmospheres. In this situation, the atmospheric envelope should be tested a distance of approximately 4 feet in the direction of travel and to each side. The Entrant's rate of progress should be slowed to accommodate the sampling speed and detector response. It is possible that the atmosphere of a confined space is safe at one level but hazardous at another.
- A test for oxygen is performed first because most combustible gas meters are oxygen dependent and will not provide reliable readings in an oxygen deficient atmosphere. Combustible gases are tested for next because the threat of fire or explosion is both more immediate and more life threatening, in most cases, than exposure to toxic gasses and vapors. If tests for toxic vapors or gases are necessary, they are performed last.

### How is "Continuous" Monitoring Performed?

- The same Air Monitoring equipment used to perform initial air monitoring is worn by the Authorized Entrants to continuously monitor that space IF INITIAL READINGS DEEM THE SPACE A "PERMIT-REQUIRED" CONFINED SPACE.
- The Authorized Entrant shall wear the Air Monitor on his/her belt for the entire duration of occupancy in a "Permit-Required" Confined Space. The Entrant shall report the air monitor readings every two (2) hours to the Attendant, who shall in turn record these results on the Confined Space Entry Permit Form.
- The Air Monitor has an alarm that warns its user when a pre-determined limit has been reached. The monitor alarm will sound when the atmosphere is *unsafe* but is still at a level that gives you enough time to exit the confined space. **THE AUTHORIZED ENTRANT SHALL EXIT THE AREA IMMEDIATELY ONCE THE AIR MONITOR ALARM HAS SOUNDED.**

## Confined Space Entry Training Guide

### What Equipment is Used During Entry into a Permit-Required Confined Space?

#### Precautionary Equipment

- "**Caution - Confined Space**" (Red and Black on White) signs are posted at the entrances to all Confined Spaces on campus.
- Barricades and/or Pylons - The university is using "*Work-Area Cone Barricades.*"

#### Ventilating Equipment

- A portable ventilator and fan are used to supply fresh air to applicable confined spaces, replacing hazardous or explosive breathing conditions with a safe atmosphere.
- The air delivery capacity is at least 600 cubic feet per minute (CFM), with two (2) ten-foot sections of lightweight, flexible duct.
- The unit uses an explosion-proof motor.

#### Rescue Equipment/Retrieval System

- **Body Harness.** The university will utilize a "parachute harness," manufactured by *Miller*. This harness is a system of adjustable straps and buckles worn over your clothing that provides a secure way to be lifted out of a confined space. A retractable lifeline is attached to the body harness of someone working in the space.
- **Wristlets.** Wristlets are loops of strong strapping material attached to each other and connected to a lifeline or lanyard. When a person's hands are inserted through the loops, he/she can be lifted by the wrists. Wristlets are used when you must lift someone through an extremely small opening.
- **Mechanical Lifting Device.** The University will utilize a *Miller* 3-Way Self retracting Lifeline Unit with Retrieval/Lowering Capacity mounted onto an 8 foot tripod. Since the University's Confined Space Policy expressly forbids "invasive" rescue, this device will be the method used exclusively to remove "downed" individuals from a confined space.

Confined Space Entry  
Training Guide

**Equipment Used During Entry into a Permit-Required Confined Space** (continued):

**Personal Protective Equipment**

- Safety Glasses (as needed)
- Hard Hat AT ALL TIMES
- Gloves, coveralls, and safety shoes impervious to chemicals or other liquids (as applicable).
- **AIR PURIFYING RESPIRATORS ARE NEVER TO BE WORN IN CONFINED SPACES. THEY PROVIDE NO PROTECTION IN OXYGEN DEFICIENT ATMOSPHERES!!**

**Miscellaneous Equipment**

- **Portable Lighting** (where applicable). Portable lighting used for work in a confined space must be shielded and explosion proof.
- **Non-Sparking Tools**
- **Fire Extinguishing Equipment.** Fire extinguishing equipment should be on hand whenever there is any danger of fire in a confined space entry.

## Confined Space Entry Training Guide

### • **What are the Common Warning Signals of an Unsafe Atmosphere?**

To protect him/herself through self-monitoring, the **Authorized Entrant** should always be aware of the following signals that something has gone wrong with the air he/she is breathing in a confined space:

- **AIR MONITOR SOUNDS ITS ALARM**
- shallow rapid breathing
- vision blurred, spots in front of eyes, vision blackouts
- exaggerated sense of feeling good
- disorientation
- profuse sweating
- ringing in the ears
- smell of solvents, gases, vapors, etc.
- slippery sweet taste on the lips
- dryness of the throat
- chest pains
- change in heart rate
- sudden skin irritation
- loss of manual dexterity
- loss of coordination
- weakness in the knees

**THE AUTHORIZED ENTRANT SHALL EXIT THE AREA IMMEDIATELY ONCE ANY OF THESE SIGNALS BECOMES APPARENT!**

**THE ATTENDANT SHOULD ALSO MONITOR THE BEHAVIOR OF THE AUTHORIZED ENTRANT(S) TO DETERMINE IF THESE SIGNALS ARE EVIDENT, AND IMMEDIATELY RETRACT THE ENTRANT IF THE ENTRANT DOES NOT EXIT ON HIS/HER OWN.**

### **What Tasks Should be Performed Upon Completion of Confined Space Operations?**

- Notify the Entry Supervisor that the job is complete.
- Gather up all equipment used for the task and for safety.
- Clean and inspect all equipment for damage.
- Return all equipment to its designated area.
- Report all equipment in need of repair or replacement to your supervisor.
- Return the Entry Form(s) to your supervisor; make certain copies of all forms are forwarded to EH&S.