

Safety Educational Webinar Series – Confined Space Entry



Why We Are Here!?!?

- Routine work can dull alertness and create a relaxed attitude.
- In many jobs the same tasks are repeated with little thought.
- We may not recognize the importance for safety because we have been doing the same task for years.

Overview

- Without some periodic reawakening to the ever-present hazards around us, lethargy deepens and the odds of an accident occurring increases.



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Introduction to Confined Spaces

Definition of a Confined Space

- Large enough for entry and work
- Limited means of entry and exit
- Not designed for continuous occupancy

Breaking the plane of the space with any part of the body is considered to be entry.



Two Types of Confined Spaces

- Non-permit confined spaces **do not** contain hazardous conditions.
- Permit-required confined spaces **do, or could,** contain hazardous conditions, such as:
 - Combustible, oxygen-depleted, or toxic atmospheres.
 - Materials capable of engulfing an entrant.
 - Inwardly-converging walls or sloped floors.
 - Moving parts.
 - Exposed electrical components.
 - Slippery surfaces.
- It may be possible to downgrade.





Elements of a Confined Space Program

- Confined space permits
- Roles and responsibilities for entry staff
- Pre-entry procedures
- Atmospheric monitoring
- Program audits

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Confined Space Permits

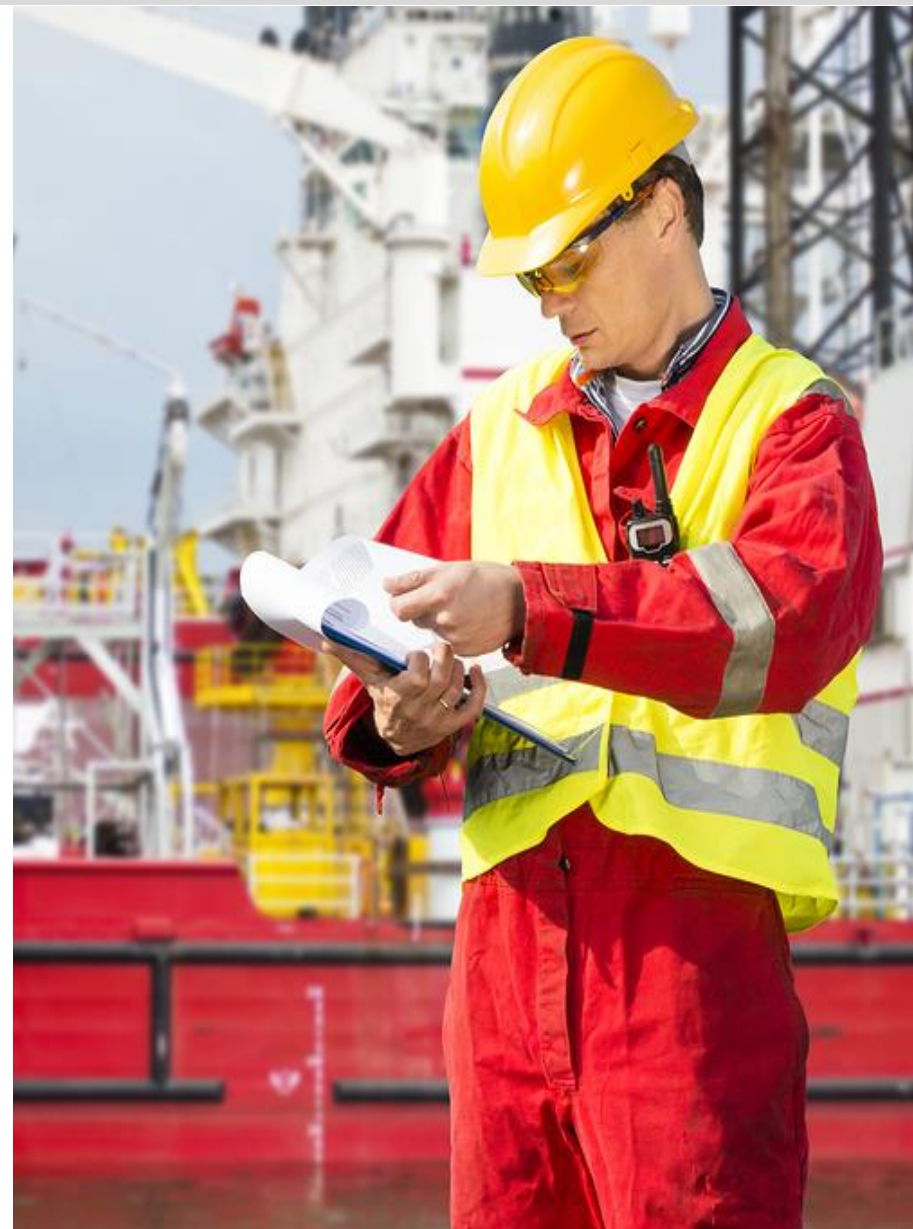
The Purpose of the Permit System

- Serves as the central element of a confined space program
- Assures that only authorized employees enter a permit-required space
- Works within your normal business operating procedures to issue and cancel permits



The Permit Process

- An entry supervisor issues a permit to a specific employee—the permit verifies that pre-entry preparations have been completed.
- Permits are issued only for the time required to complete an assignment.
- They must be posted at entrances or otherwise made available to the entrant.
- The entry supervisor terminates entry and cancels the permit when the assignment is completed or when new conditions exist.
- The employer notes any new conditions on the canceled permit and keeps all canceled entry permits for at least one year.



Information Listed on the Permit

- Space to be entered
- Purpose for entry
- Date and duration of entry
- Name of attendant and entrant
- Signature or initial of supervisor
- Hazards of the space
- Methods to isolate the space and eliminate or control the hazards
- Acceptable entry conditions
- Test results and times
- Name of the tester
- Rescue services contact information and procedures
- Communication procedures
- Equipment to be provided
- Additional permits, such as for hot work

Preventing Unauthorized Entry

- Inventory
- Signage at entry
- Training



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Roles and Responsibilities

Overview of Personnel

Attendant

Entrant

Entry Supervisor

Rescue Personnel

Employer

Attendants

- Attend a pre-entry briefing.
- Evaluate and know the hazards of the space.
- Control access to the space.
- Monitor and maintain communication with the entrant.
- Trigger evacuations.
- Summon rescue.
- Never enter the confined space.



Entrants

- Attend a pre-entry briefing.
- Know the hazards of the space.
- Secure entry permits.
- Use the appropriate personal protective equipment (PPE).
- Communicate with attendants.
- Evacuate immediately if there are any signs of danger.



Entry Supervisors

- Understand the hazards of the space.
- Verify completion of permit conditions:
 - Tests
 - Monitoring
 - Procedures
 - Equipment
- Assure that rescue personnel are readily available.
- Sign-off on entry and exit from the confined space.



Rescue and Emergency Personnel

The personnel:

- Can be a contracted service or an in-house team.
- Are trained to perform rescue duties in the confined space.
- Are equipped with PPE and rescue equipment.
- Perform entry and non-entry rescue.
- Are trained in first aid and CPR.



Rescue and Emergency Personnel

Equipment requirements:

- Non-entry rescue equipment is required unless the equipment would hinder rescue.
- Entrants must wear a full body harness with a lifeline connection in back.
- Mechanical retrieval is required in spaces deeper than five feet.



Employers

Employers' responsibilities include the following:

- Providing all necessary PPE and rescue equipment
- If using local emergency services, finding out when they will be available and unavailable to respond
- If not using a full permit system, eliminating or isolating all potential hazards before permitting employees to enter the space
- Training all employees in a language and vocabulary they understand
- Conducting training:
 - Before work begins
 - When job duties change or when new hazards arise
 - If an employee's job performance shows deficiencies
- Documenting training and assuring competency

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Pre-entry Procedures

Confined Space Hazards

Assess all potential hazards.

- Atmospheric hazards
- Physical hazards
- Engulfment hazards
- Chemical hazards
- Biological hazards



Pre-entry Meeting

Steps:

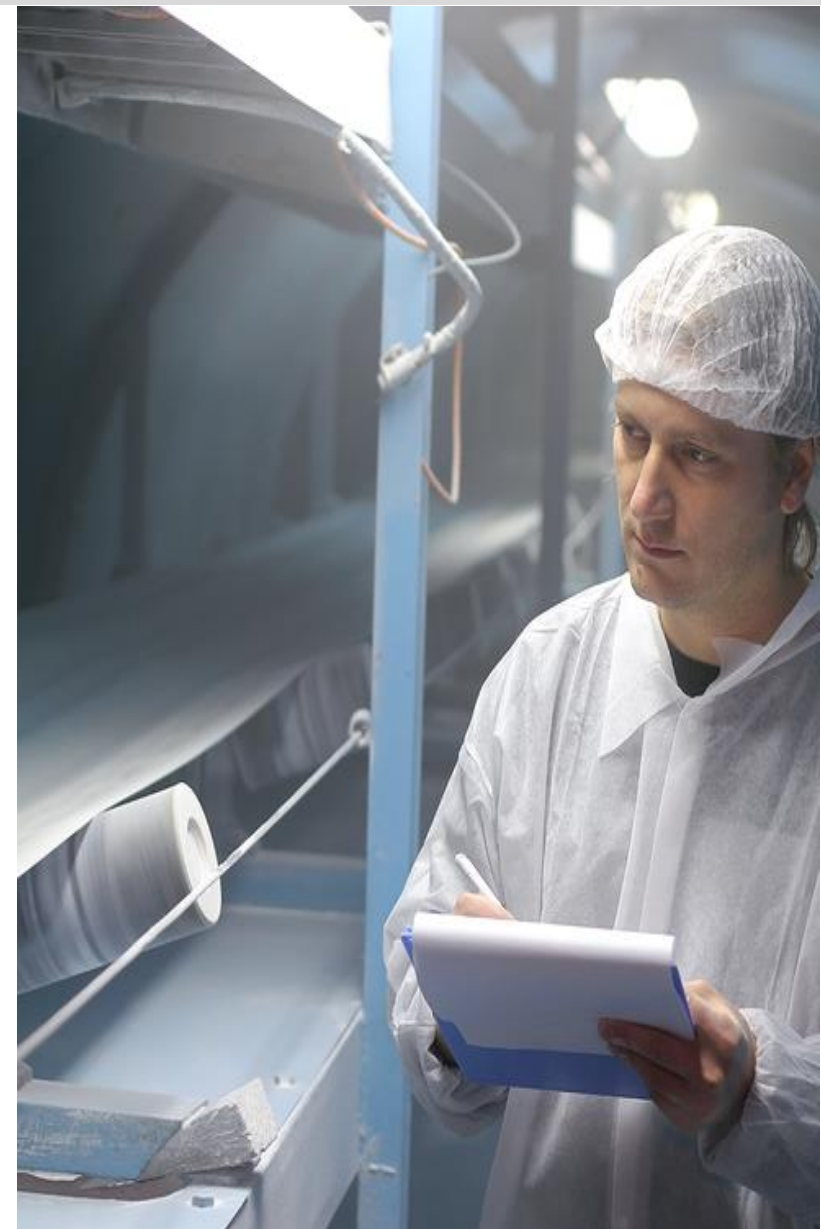
- Review the hazard assessment.
- Discuss communication and rescue protocol.
- Assess how and where to ventilate.
- Consider access and egress safety.
- Confirm that PPE is available.



Evaluating the Space

Before entry:

- Evaluate the space.
- Determine what it was used for previously.
- Review any pertinent safety data sheets (SDSs) to determine physical and chemical properties.
- Conduct a visual inspection.
- Monitor the atmosphere.



Physical Hazards

- Moving parts
- Electrical components
- Process hazards
- Inwardly converging walls
- Falling and tripping hazards
- Chemical hazards
- Extreme temperatures
- Hazardous energy
- Radiation



Engulfment Hazards

- Prepare the space by draining and cleaning it.
- Isolate the space to prevent material inflow. Do this by:
 - Blinding the lines.
 - Disconnecting and misaligning the lines.
 - Double blocking and bleeding the valves.



Ventilation

- Use it to correct hazardous atmospheres.
- When in doubt, ventilate.
- Use local exhaust ventilation in addition to supply ventilation if necessary.
- Inert or purge the space, then ventilate.



A space requiring ventilation for entry cannot be downgraded to a non-permit-required space.



Determination of Purge Time

Purge times can be estimated by the following:

$$T = 7.5(V)/C$$

T = purge time in minutes

V = the volume of the space in ft³

C = effective blower capacity CFM

Purging Time Example

Situation:

An estimation of purging time is needed for a 800 ft³ deep neck manhole. The effective blower capacity is 250 CFM.

$$T = 7.5(V)/C$$

$$T = 7.5 (800) / 250$$

$$T = 24 \text{ minutes}$$

Lockout/Tagout

Lockout and tagout all sources of hazardous energy before employees enter the space.

Potential energy sources:

- Electricity
- Hydraulic
- Steam
- Drive mechanisms
- Pneumatic
- Gravity
- All other potential or kinetic energy sources



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Atmospheric Monitoring

Atmospheric Testing Procedures

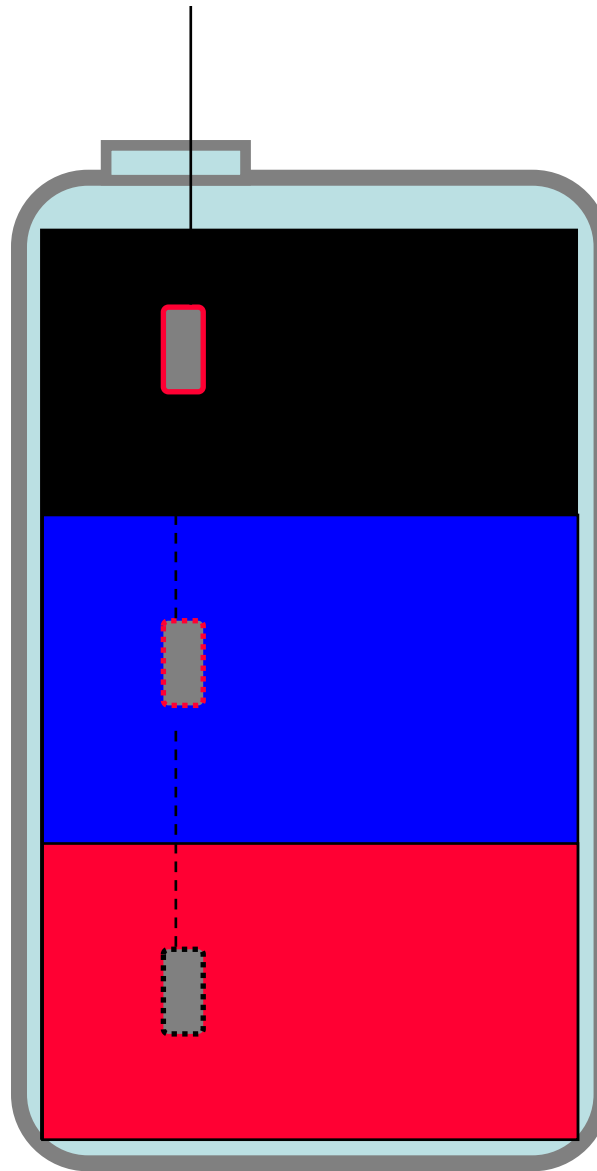
- Test before ventilating.
- Select the appropriate instruments.
- Calibrate the instruments using manufacturer-recommended calibration methods.
- Always test the space from the outside.



Assure that you are trained in the use of all monitoring equipment.

Always test the air at various levels to be sure that the entire space is safe.

Good air near the opening does NOT mean there is good air at the bottom!



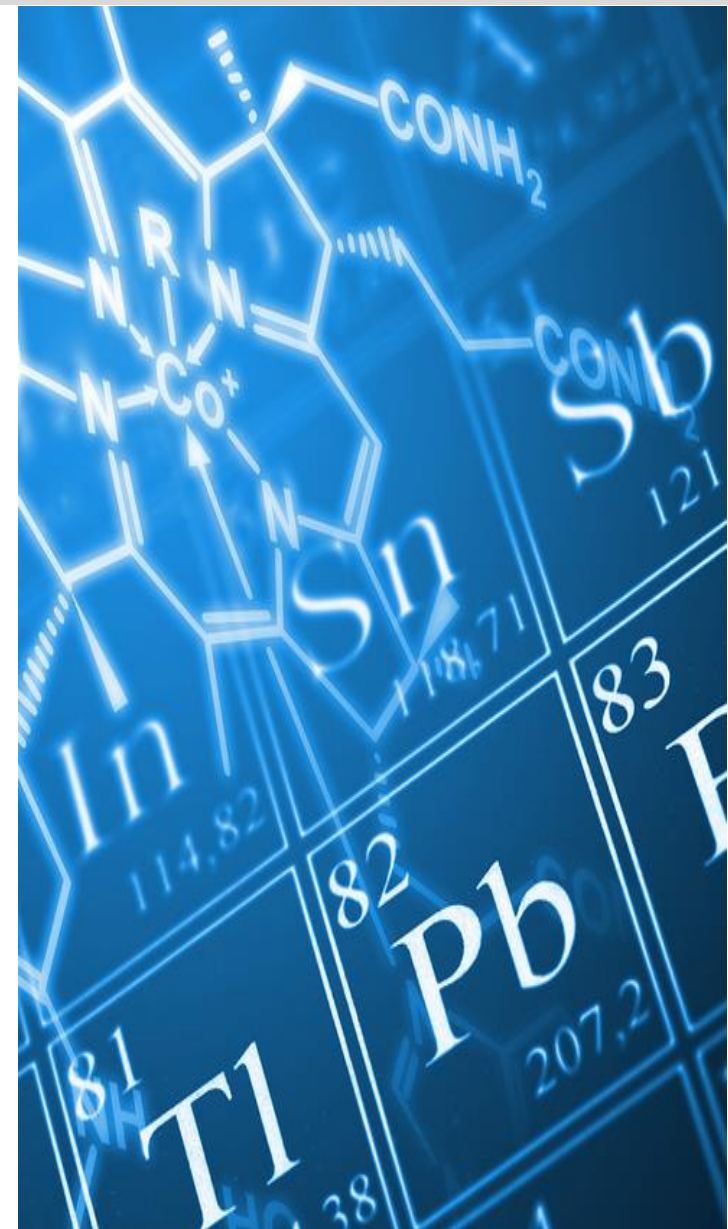
Good Air

Poor Air

Deadly Air

Atmosphere Composition

- 21% oxygen
- 78% nitrogen
- 1% all other gases
 - CO₂
 - Argon
 - Neon
 - Water vapor
 - Methane
 - Trace gases



Atmosphere Tests

Test in the following order:

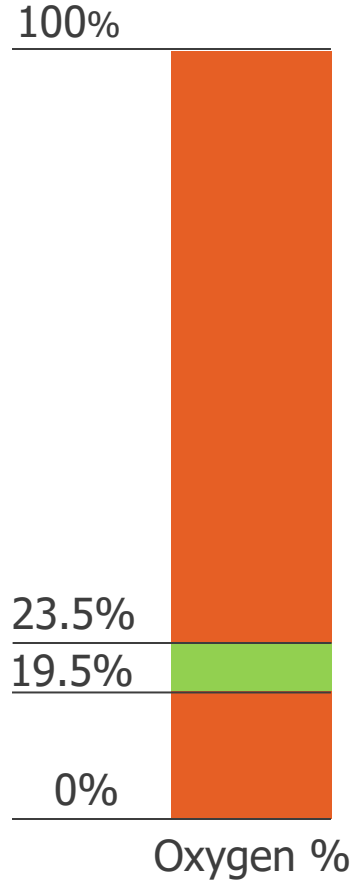
1. Oxygen
2. Flammable gases or vapors
3. Toxic gases or vapors



Oxygen Hazards

Both oxygen-enriched and oxygen-deficient atmospheres present hazards.

Acceptable oxygen levels are between 19.5% and 23.5%.



Higher oxygen levels present a risk of combustion.



Lower levels present a risk of suffocation or poisoning by other hazardous gases.

Health Effects of Oxygen Deficiency

Oxygen content	Health effects
21.5%	Oxygen content in normal air, no adverse effects.
19.5%	Minimum amount of oxygen required for work
19.5% - 12%	Increased pulse and respiration, impaired judgment, coordination loss
12% - 10%	Disturbed respiration, fatigue, faulty judgment, poor circulation, symptoms within seconds to minutes
10% - 6%	Nausea, vomiting, inability to move, loss of consciousness, death
6% - 0%	Convulsions, gasping respiration, cessation of breathing, cardiac arrest, death within minutes

Causes of Oxygen Deficiency

- Hot work
- Purging the space
- Displacement by other gases



Oxygen Enrichment

Oxygen enrichment can make things burn easier, quicker, and more intense, which dramatically promotes and accelerates combustion.

Any environment with a concentration of oxygen greater than 23% is considered to be an **enriched environment**.

Dangers:

- Increased flammability
- Accelerated combustion



For this reason, never use oxygen to ventilate a confined space.

Sources of Flammable Gases and Vapors

Flammable gases and vapors other than oxygen can be introduced into confined spaces in a variety of ways:

- Natural
- Chemical
- Industrial
- Particle



Flammability Range

Flammability is present when the fuel-to-air mixture is between the lower explosive limit and the upper explosive limit.

- The **lower explosive limit (LEL)** is the minimum concentration.
- The **upper explosive limit (UEL)** is the maximum concentration.
- The **flammability range** is the range between the LEL and the UEL.
- Atmospheres in this range will burn or explode if an ignition source is present.
- Combustible gas and vapor reading instruments take measurements in % LEL.



For safe entry, combustible gas concentrations must be below 10% LEL.

Toxic Gases or Vapors

Examine the atmosphere for toxic gases or vapors.

Sources:

- Environmental conditions
- Processes

Vapor density and pressure:

- The vapor density of normal air is 1.
- Materials with a higher vapor density will settle at the bottom.
- Liquids with a high vapor pressure will evaporate quickly and may create hazardous conditions.



Permissible Exposure Limits

Permissible exposure limits (PELs) are the threshold limits for exposure to toxic atmospheres.

- They are based on time-weighted averages for employee exposure.
- PELS cannot be safely exceeded.



IDLH

Immediately Dangerous to Life or Health (IDLH) concentrations are concentrations so high that they present **an immediate risk of injury, sickness, or death** to an exposed employee.

- They may cause irreversible adverse health effects.
- They interfere with the ability to escape.
- **Never enter or work in an IDLH atmosphere.**



IDLH

- Any time a limit is exceeded, no matter what the reason, all personnel shall immediately exit the space, and no others shall enter until atmospheric conditions are returned to safe levels.
- ENTRANT(S) must evacuate immediately.
- ATTENDANT must order evacuation immediately.

Bump Test vs Calibration?

- Two methods of verifying instrument accuracy.
- Bump test is performed by briefly exposing the sensors to their target gas.
- When and how often?



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Additional Work Practices

Procedures During Entry

- Enter the space using the proper equipment.
- Wear the required PPE.
- Adhere to safety rules.
- Maintain communication with the attendant.
- Continually monitor the atmosphere of the space.
- Place barricades or shields up after entry has occurred.

Changing Conditions

If you identify a new hazard or if conditions change:

- Immediately leave the space.
- Deny entry.
- Cancel the permit.
- Evaluate the space to determine the cause.
- Before re-entry, the hazard must be eliminated, and the permit must be reinstated.



On construction sites, if confined space entry conditions change from those listed on the permit, instead of being cancelled, permits may be suspended and then reinstated once the space is restored to the listed conditions.



Inform contractors and vendors of all permit-required confined spaces and entry requirements.

Reclassification

Reclassification can happen:

- When there are changes in a non-permit confined space's use or configuration and the re-evaluation shows that reclassification is appropriate.
- When testing and inspection data prove that a permit-required confined space no longer poses a hazard.

Reclassification from a permit-required space to a non-permit space may only occur:

- If the space does not contain actual or potential atmospheric or engulfment hazards.
- If all hazards may be eliminated without entry into the space.

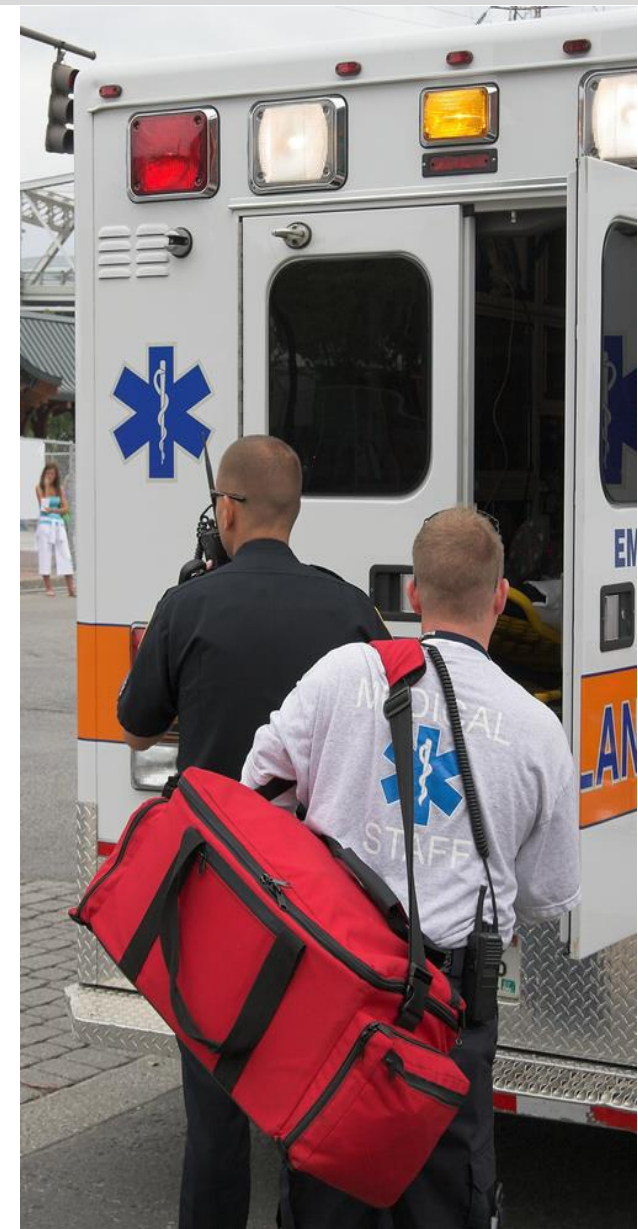
Emergency Response

If an emergency occurs:

- Entrants should attempt self rescue.
- A non-entry rescue is preferable to an entry rescue.
- If non-entry rescue is not possible, then engage the rescue team.



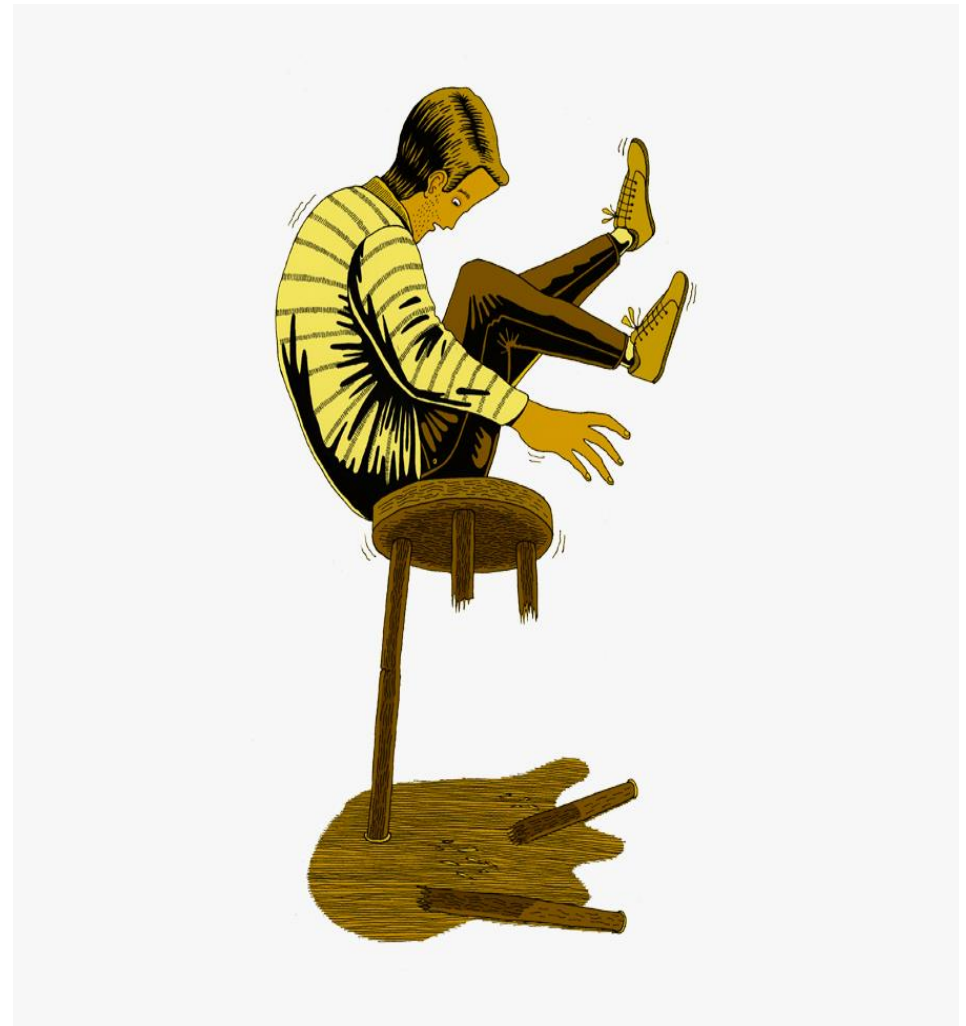
Coordinate regularly with rescue services to assure quick response.



Rescue Tripod

System should be able to meet the requirements for:

1. Lowering/raising;
2. Fall protection;
3. Rescue/retrieval.



Rescue Tripod

Know the components:

- Rescue/Retrieval Winch
- Combination Rescue Winch/Self Retracting Lifeline
- Self Retracting Lifeline



Program Audits

Self-audit checklist:

- Entry postings and permits
- Training and documentation
- PPE
- Rescue plan and equipment
- Monitoring equipment
- Hazardous material assessments
- Lockout/tagout procedures
- Ventilation procedures
- Atmospheric testing procedures



Retain documentation of all audits.

Program Audits

Contractor review:

- Injury data and references
- Certificates of insurance
- Training records
- Onsite safety observation



Summary

- Confined spaces that contain hazards need to be regulated with a permit program.
- The key elements of a permit program are the roles of entrants, attendants, entry supervisors, and rescue personnel.
- Pre-entry procedures such as monitoring, and ventilating must be observed.
- Regular program audits will help maintain the safety of employees.

Questions, Comments or Concerns?



Contact Information



murrayins.com
assuredpartners.com



Dario Stanley, GSP

Risk Control Specialist

39 N Duke Street, Lancaster, PA 17602

d: 443-546-6416

o: 717-581-6151

e: Dario.Stanley@assuredpartners.com or

e: Dstanley@murrayins.com

AP Murray – Lancaster, PA