Confined Space Entry

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Goal: Familiarize yourself with the hazards of confined space entry, the purpose of a confined space program, individual responsibilities, and the basics in atmospheric monitoring.

- Introduction to Confined Spaces
- Confined Space Permits
- Roles and Responsibilities
- Pre-entry Procedures
- Atmospheric Monitoring
- Additional Work Practices
Introduction to Confined Spaces

What you need to know:

- Definition of a confined space.
- Two types of confined spaces.
- Examples of confined spaces.
- Elements of the confined space program.
Definition of a Confined Space

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

* A space not designed for human use! *
Two types of Confined Spaces

- Non-permit confined spaces **do not** contain hazardous conditions.
- Permit-required confined spaces **do or could** contain a hazardous condition, 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
Examples

- Storage vaults
- Railcars
- Chemical storage tanks
- Plumbing or electrical vaults
- Drainage sumps
- Grain silos
- Hoppers
Elements of a Confined Space Program

- Confined space permits
- Roles and responsible for entry staff
- Pre-entry procedures
- Atmospheric monitoring
- Program Audits
Confined Space Permits

What you need to know:

- The purpose of the permit system
- The permit process
- Information listed on the permit
- Preventing unauthorized entry
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 System 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 Permit System Process

- 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.
The Purpose of the Permit System

- 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
The Permit System Process

- Inventory
- Signage at entry
- Training
Confined Space Permits

What you need to know:

The roles and responsibilities of:

- Attendants
- Entrants
- Entry supervisors
- Rescue and emergency personnel
- Employers
- Controlling contractors
- Host employers
- Subcontractors
- Communication methods on construction sites
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.
Entry Supervisors

The personnel:

- Can be a contracted service or an in-house team.
- Are trained to perform rescue duties in the confined space.
- Is equipped with PPE and rescue equipment.
- Perform entry and non-entry rescue.
- Is 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, find out when they will be available and unavailable to respond.
- Training all employees in a language and vocabulary they understand.

- Conduct training:
  - Before work begins.
  - When job duties change or when new hazards arise.
  - If an employee's job performance shows deficiencies.
Employers’ responsibilities include the following:

- Documenting, training and assuring competency.
- On construction sites, assuring that a competent person assesses the site and identifies all potential confined spaces.
Controlling Contractors, Host Employers, and Subcontractors

- **Controlling contractors** act as the central point of communication between all parties and relay information between the host employers and subcontractors. They also assure that no one conducts activities that may create hazardous conditions during entry operations.
Controlling Contractors, Host Employers, and Subcontractors

- **Host employers** are responsible for providing all known information about the confined space to the controlling contractor.
- **Subcontractors** are responsible for communicating their entry plan in detail and any hazards they find to the controlling contractor.
Communication on Construction Sites

Employers, contractors, and subcontractors must remain in contact with each other before, during, and after entry procedures to assure that everyone is always aware of current hazards.
Pre-entry Procedures

What you need to know:

- Confined space hazards
- The pre-entry meeting steps
- Evaluating the space
- Identifying physical hazards
- Controlling engulfment hazards
- Ventilation requirements
- Lockout/tagout requirements
Confined Space Hazard

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
Physical 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.
  - On construction sites, continuously monitor engulfment hazards with either spotters or electronic sensors.
Ventilation

- Used 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
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
Atmospheric Monitoring

What you need to know:

• Atmospheric testing procedures
• Atmosphere composition
• Atmosphere tests
• Oxygen hazards
• Health effects and causes of oxygen deficiency
• Sources of flammable gases and vapors
• Flammability range
• Oxygen deficiency and enrichment
• Permissible exposure limits and IDLH
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
- On construction sites, perform continuous atmospheric monitoring whenever possible

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

- 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

<table>
<thead>
<tr>
<th>Oxygen Content</th>
<th>Health Effects</th>
</tr>
</thead>
<tbody>
<tr>
<td>21.5%</td>
<td>Oxygen content in normal air, no adverse effects</td>
</tr>
<tr>
<td>19.5%</td>
<td>Minimum amount of oxygen required for work</td>
</tr>
<tr>
<td>19.5% - 12%</td>
<td>Increased pulse and respiration, impaired judgment, coordination loss</td>
</tr>
<tr>
<td>12% - 10%</td>
<td>Disturbed respiration, fatigue, faulty judgment, poor circulation, symptoms within seconds to minutes</td>
</tr>
<tr>
<td>10% - 6%</td>
<td>Nausea, vomiting, inability to move, loss of consciousness, death</td>
</tr>
<tr>
<td>6% - 0%</td>
<td>Convulsions, gasping respiration, cessation of breathing, cardiac arrest, death within minutes</td>
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Causes of Oxygen Deficiency

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

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

- Natural
- Chemical
- Industrial
- Particle
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.

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

Limits of Flammability

Lower Explosive Limit (LEL)

Upper Explosive Limit (UEL)

% Natural gas in air

1 3 5 7 9 11 13 15 17
Toxic Gases or Vapours

Examine the atmosphere for toxic gases or vapours.

Sources:

• Environmental conditions
• Processes

Vapor Density and Pressure:

• The vapor density of air is 1
• Materials with a vapor density >1 will settle to the bottom
• Liquids with a high vapor pressure will evaporate quickly and may create hazardous conditions
Permissible Exposure Limits

- Permissible Exposure Limits (PEL) are the threshold limit for exposure to toxic atmospheres.
- They are time weighted averages for exposure over an eight hour period.
- Permissible exposure limits cannot be safely exceeded.
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
Additional Work Practices

What you need to know:

- Procedures during entry
- Responding to changing conditions
- Reclassification requirements
- Emergency response
- Program audit requirements
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 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.
Program Audits

Self-audit checklist:
- Entry postings and permits
- Training & 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
In 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.
Conclusion

Do you feel you have the knowledge to recognize the hazards of confined space entry? Do you know the individual responsibilities and basics in atmospheric monitoring?

- What a Confined Spaces is
- Confined Space Permits
- Roles and Responsibilities
- Pre-entry Procedures
- Atmospheric Monitoring
- Additional Work Practices
Questions or Concerns?

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