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Working in Confined Spaces:
Advanced Safety & Risk
Management



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Presenter



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Disclaimer

This presentation is not intended to be a comprehensive program covering all aspects of this topic. All technicians are encouraged to read and follow all applicable standards, codes and regulations related to this topic.

- ✓ It is the responsibility of each individual contractor to follow local building codes and licensing requirements and to work safely in accordance with OSHA guidelines.
- ✓ It is the contractor's responsibility to take proper precautions on each project to prevent cross contamination. Always take the health and safety of the building occupants into consideration before you conduct any cleaning procedures.
- ✓ All of the following tips are only general tips. They do not cover every situation and it is your responsibility to adapt these tips to the individual system you are working on.
- ✓ The Instructor is not responsible in any way for the work you perform after viewing this slide show. You are responsible for your own work.
- ✓ The views and opinions following are the instructors opinions and not necessarily the official position of the National Air Duct Cleaners Association.

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What We'll Learn

- Overview & Risks
- Definitions & Classifications
- Hazards & Controls
- Procedures & Responsibilities

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Confined Space Risk

USA
Coast Guard investigating "confined space" deaths of 2 crew members on barge off Alaska
Washington Post | 04/11/2024 12:01 PM EDT | 1/2024

Six dead in dairy accident in rural Colorado plains area, OSHA investigating
USA Today | 04/11/2024 12:01 PM EDT | 1/2024

NATION
3 die of suffocation in sewer manhole
Entertainment Weekly | The Philippine Star | 04/11/2024 12:01 PM EDT | 1/2024

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Confined Space Risk

- Confined-space incidents are relatively infrequent but can be **severe** when they occur.
- Atmospheric hazards and engulfment / entrapment are among the most serious risks.
- Would-be rescuers can also become victims
 - As a result, rescue planning is essential.
- Treat every entry as a planned operation, not a routine task.**

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OSHA Requirements

- Evaluate workplaces to identify confined and permit-required confined spaces.
- Post appropriate danger signs where permit-required spaces are located.
- Establish a written permit-required confined space program when employees enter.
- Provide training, maintain the program, and retain required records.



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Administration



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Evaluating a Space

- Determine whether the space meets OSHA's confined-space definition.
- If it is a confined space, determine whether it is permit-required.
- For PRCS, determine whether alternate-entry or full permit procedures apply.
- Plan hazard controls, atmospheric testing, and rescue before entry.

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Confined Space Definition

- Large enough and configured for an employee to bodily enter.
- Has limited or restricted means of entry or exit.
- Is not designed for continuous employee occupancy.

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Examples of Confined Spaces

- Manholes, vaults, pits and excavations.
- Tanks, vessels, furnaces and hoppers.
- Storage bins and silos.
- Pipelines and other restricted-access spaces.



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Permit-Required Confined Space (PRCS)

- Contains (or could contain) a hazardous atmosphere.
- Contains material that could engulf an entrant.
- Has a configuration that could trap or asphyxiate an entrant.
- Contains another recognized serious safety or health hazard.



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Non-Permit Confined Space

- Does not contain, or have the potential to contain, atmospheric hazards.
- Does not contain a hazard capable of causing death or serious harm.
- Reevaluate the space if its use or configuration changes.

• **Emergency planning remains important even for non-permit spaces.**

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Reclassification

- A PRCS may be reclassified only when hazards are eliminated—not merely controlled.
- If entry is required to eliminate hazards, entry must initially follow PRCS procedures.
- Document the basis for reclassification.
- If hazards return, exit and reevaluate the space.

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PRCS Written Program

- Identify and clearly demarcate confined spaces.
- Evaluate hazards and establish isolation / elimination controls.
- Provide employee training and appropriate equipment.
- Establish permit procedures, atmospheric monitoring, & rescue plans.



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Confined Space Hazard Assessment

- Identify hazards normally present in the space.
- Anticipate hazards and emergencies that could develop.
- Consider hazards introduced by the work being performed.
- Evaluate engulfment, entrapment, falls, energy, thermal, chemical, and atmospheric hazards.



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Hazards: Engulfment

- Sudden releases of solids, liquids, fluids, or dense gases can engulf entrants.
- Identify stored or flowing materials before entry.
- Isolate sources and prevent unexpected releases.
- Use warning/detection systems when hazards cannot be fully isolated.



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Hazards: Entrapment & Falls

- Converging walls or sloped/tapered floors can trap or asphyxiate entrants.
- Secure or remove loose materials before entry.
- Barricade openings to prevent falling objects and unauthorized access.
- Inspect ladders, scaffolds, and platforms; use fall protection when required.



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Hazards: Hazardous Energies

- Potential sources: mechanical, electrical, pneumatic, hydraulic, gravity, kinetic, & chemical energy.
- Identify all hazardous energy sources
- Review equipment-specific Energy Control Procedures.
- Isolate and lock out energy sources before entry.

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Hazards: Oxygen Deficiency & Enrichment

- Oxygen can be consumed by people, combustion, chemical reactions, or decay.
- Inert gases can displace oxygen without being toxic themselves.
- Oxygen can become enriched when pure oxygen is introduced.
- Maintain acceptable oxygen conditions and prevent uncontrolled gas introduction.

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Hazards: Hazardous Atmospheres

- Hazardous atmospheres may be flammable, oxygen-deficient/enriched, or toxic.
- Oxygen below 19.5% or above 23.5% is hazardous.
- Concentrations above applicable OSHA exposure limits are hazardous.
- Any atmosphere considered IDLH requires immediate protective action.

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Hazards: Flammable Atmospheres

- Fire or explosion requires fuel, oxygen, and an ignition source.
- Flammable gases may be introduced by the space or by the work.
- Residual materials can vaporize and create an explosive atmosphere.
- Control hot work and ignition sources; monitor continuously as required.



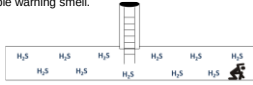
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Hazards: Toxic Atmospheres

- Common toxic gases include carbon monoxide (CO) and hydrogen sulfide (H₂S).
- Irritant gases may include ammonia, chlorine, sulfur dioxide, ozone, and nitrogen dioxide.
- Simple asphyxiants inert (nitrogen, acetylene, argon, LP gas, methane) displace oxygen; chemical asphyxiants interfere with oxygen use.
- Do not rely on odor—some hazardous gases have no reliable warning smell.



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Hazards: Toxic Atmospheres

CO Level (ppm)	Characteristic / Effect
0 – 20	Grade "D" breathing air (legal for compressed or airline breathing)
25	ACGIH TLV (8-hr TWA)
50	OSHA PEL (8-hour TWA)
100	Headache and discomfort after 3 hours
200	NIOSH Ceiling Limit – Headache in 2-3 hours
400	Frontal headache and nausea in 1-2 hours
800	Headache, dizziness, nausea in 45 minutes; collapse and possible death in 2 hours
1200	NIOSH IDLH Concentration

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Hazards: Toxicity & Chemical Hazards

- Identify residues and materials previously stored or used in the space.
- Consider hazards created by painting, cleaning, degreasing, welding, cutting, or burning.
- Check adjacent areas for possible migration or contamination.
- Review SDS information and determine required PPE and preparation procedures.

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Hazards: Thermal Stress

- PPE, heat-producing work, and confined-space conditions can increase heat stress.
- Watch for heavy sweating, dizziness, headache, nausea, cramps, fatigue, and weakness.
- Heat stroke can progress to confusion, rapid heart rate, fainting, and loss of consciousness.
- Plan controls, monitor conditions, and respond promptly to symptoms.



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Hazards: Thermal Stress

Thermal Stress – Heat Related Emergencies

Heat Exhaustion	Can Lead To	Heat Stroke
• Heavy sweating • Pale skin • Dizziness • Headache • Nausea/vomiting • Muscle cramps • Fatigue • Weakness		• High body temperature • Red, hot, dry skin • Confusion • Agitation • Rapid heart rate • Nausea • Throbbing headache • Fainting • Loss of consciousness

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Safety

Controls: Lockout / Tagout (LOTO)

Equipment Examples

- HVAC units, electric heaters, fan pulleys, fan blades

General Procedures

- Training
- Knowledge of equipment
- De-energize electrical & mechanical hazards
- Remove potential or stored energy
- Verify de-energized stated



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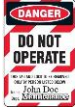


Safety

Controls: Lockout / Tagout (LOTO)

Importance of Lockout / Tagout

- Eliminate potential startups
 - New personnel or shift change
 - Computer controls and overrides
 - Mistakes or errors
- Redundancy



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Controls: Hazard Control & Mitigation



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Controls: Ventilation

- "Solution to Pollution is Dilution"
- Position blowers and ducts to exchange air and protect the breathing zone.
- **Use a clean air source.**
- Continue forced-air ventilation while entrants are in the space when required.



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Controls: Hazard Control & Mitigation

- Hierarchy of controls: eliminate hazards where possible, then engineer or administratively control them.
- Key methods include LOTO, ventilation, purging / inerting / flushing, site controls, detection systems, and PPE.
- Verify controls are installed, functioning, and effective before entry.
- **Reassess controls whenever conditions change.**

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Controls: Purging, Inerting & Flushing

- Purging removes and drains substances from space.
- Inerting replaces the atmosphere with a non-reactive gas to eliminate a combustible atmosphere.
- Flushing uses a non-reactive substance or neutralizer to remove residues.
- Verify the resulting conditions through appropriate testing before entry.

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Procedures: Site Restriction & Detection

- Prevent unauthorized entry & demarcate work area.
- Protect openings with barriers and control nearby vehicle/pedestrian hazards.
- Use early-warning systems for hazards such as potential flash flooding.
- Ensure alarms or lookouts can quickly alert entrants and attendants.



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Procedures: PPE & Entry Readiness

- PPE is the last line of defense after feasible engineering and work-practice controls.
- Select respiratory protection and other PPE appropriate to identified hazards.
- Provide safe entry/exit and emergency-extrication equipment.
- Inspect and use equipment according to the program and training.

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Procedures: Entry, Monitoring & Permits

- Entry begins when any part of an entrant's body passes through the PRCS opening.
- Test before entry: oxygen first, then combustible gases/vapors, then toxic gases/vapors.
- Sample at multiple levels and locations; account for stratified atmospheres and meter response time.



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Procedures: Entry, Monitoring & Permits

- Complete the permit, verify acceptable conditions, maintain monitoring, and terminate entry when conditions change.



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Procedures: Entry, Monitoring & Permits

Acceptable Entry Conditions (Standard ALARM Settings)				
Sensor Type	Low	High	STEL	TWA
O ₂ (Oxygen)	19.5%	23.0%	NA	NA
LEL (Lower Explosive Limit)	10% of the LEL	20% of the LEL	NA	NA
CO (Carbon Monoxide)	35 PPM	100 PPM	100 PPM	35 PPM
H ₂ S (Hydrogen Sulfide)	10 PPM	15 PPM	15 PPM	10 PPM

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Roles, Rescue & Program Maintenance

- **Authorized entrants:** Need to understand and recognize hazards, communicate with the attendant, and evacuate when required.
- **Attendants:** Remain outside, monitor conditions, control entry, and summon rescue.
- **Entry Supervisors:** Verify controls, testing, permits, and rescue availability.
- Prioritize self-rescue and non-entry rescue; maintain training and required records.

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Thank you
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