



Oregon Department of Transportation



**Confined Spaces:
Awareness Can Save Your
Life**

Presentation Overview



- ✧ **ODOT Written Program**
- ✧ **How to Identify a Confined Space.**
- ✧ **How to Perform a Hazard Assessment.**
- ✧ **Entry Permit Planning**

The ODOT Policy

OCCUPATIONAL SAFETY & HEALTH



Number	Reference
PRO96003	29 CFR 1910.146
Effective Date	Revision Number
January 1, 1997	0
Number of Pages	Annual Review Date
1	January 1, 1998



PERMIT REQUIRED CONFINED SPACE (PRCS)

A. PURPOSE

To establish safe and effective guidelines for the protection of employees from entering any PRCS, vat, or tank without the proper safety equipment, procedures and verification of atmospheric conditions, and training.

B. GUIDELINES

Scope

1. This program applies to any operation that requires ODOT employees to enter or work inside any existing tank, tank car, sewer, manhole, sump, vault, vat, process vessel, pit, tunnel, or those spaces that meet the definition of a confined space found in Appendix A.

Definitions

1. **Acceptable Entry Conditions** - means the conditions that must exist in a permit required confined space to allow entry and to ensure that employees involved with a permit-required confined space entry can safely enter and work. Acceptable conditions for ODOT employees includes:
 - oxygen content greater than 19.5% and less than 23.5%;
 - lower explosive limits less than 10%;
 - toxic chemical within the air less than 50% of the OR-OSHA permissible exposure limit;
 - any other condition as identified on the confined space permit.
 2. **Attendant** - an individual stationed outside the permit required confined space who is trained as required by CFR 1910.146 and who monitors the authorized entrants inside the permit required confined space.
 3. **Engulfment** - the surrounding and effective capture of a person by a solid material.
 4. **Entry** - the act by which a person intentionally passes through an opening into a permit required confined space. The entrant is considered to have entered as soon as any part of the entrant's body breaks the plane of an opening into the space.
 5. **Entry Supervisor** - means the person responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, for authorizing entry and overseeing entry operations, and for terminating entry as required.
 6. **Hot Work Permit** - the employer's written authorization to perform operations which could provide a source of ignition, such as riveting, welding, cutting, burning or heating.
- Immediately Dangerous to Life or Health (IDLH)** - any condition which poses an immediate threat of loss of life; may result in irreversible or immediate-severe health effects; may result in eye damage; irritation or other conditions which could impair escape from the permit space.

• What's required by the ODOT Program?

- ★ Confined Space Inventory
- ★ Hazard Assessment
- ★ Entry Permit for Each PRCS
 - ❖ General CS Information
 - ❖ Logistics and Resources
 - ❖ External Hazards and Control
 - ❖ Internal Hazards and Control
 - ❖ Self-Created Hazards and Control
 - ❖ Termination Activities
 - ❖ Contractor Requirements



What are the Risks



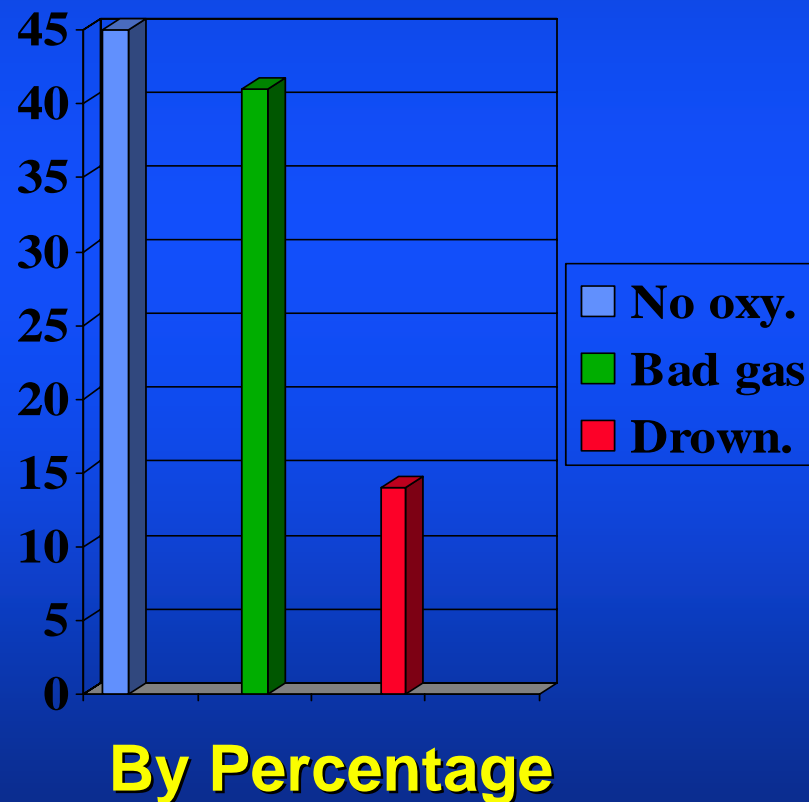
✧ **Fatalities**

✧ **Injured Employees**

✧ **OSHA Citations**

Confined Space Fatalities

- 1980-1990
- 670 workers killed
- Excluding:
 - ▶ falls
 - ▶ electrocution
 - ▶ crushing, etc.





Factors Leading to CS Deaths

- **Failure to:**
 - Recognize Hazards
 - Control Hazards
 - ▶ proper lockout/tagout
 - ▶ use of proper equipment
 - ▶ personal protective
 - ▶ work tools
- **Rescue of Injured Workers:**
 - Multiple deaths, usually from rescue attempts; 50% of all fatalities
 - Pre-planning is essential!!!

Lack of Planning



Confined Space Accident

- **Workers Die in Underground Valve Pit**
 - ★ low oxygen - stagnant water & rusting valves
- **Two Dead, Five Injured in Confined Space Incidents in Oregon**
 - ★ low oxygen
 - ★ high carbon dioxide - (algae growth & bacteria bloom).



How to Identify a Confined Space.

A space that is

- ✧ large enough so a worker can bodily enter;
- ✧ has limited/restricted means for entry/ exit;
- ✧ is not designed for continuous worker occupancy.



Examples of Confined Spaces

- ✧ Utility Vaults
- ✧ Manholes
- ✧ Septic Tanks
- ✧ Pipelines
- ✧ Pump Stations
- ✧ Water Trucks
- ✧ Bridge Structures
- ✧ Culverts
- ✧ Standpipes
- ✧ Chemical Storage Tanks
- ✧ Catch Basins
- ✧ Oil/Water Separators



Manholes





Standpipes





Catch Basins





Irrigation Pump Station



Irrigation Pump Station (Inside)





Oil/Water Separator





Glenn Jackson Bridge, I-205





Glenn Jackson Bridge Concrete Box Girders



Confined Space Inventory Form

OREGON DEPARTMENT OF TRANSPORTATION

APPENDIX A: Confined Space Inventory Form

Section Name:	Manager Name:	Date:
---------------	---------------	-------

Name of Space:	Location	Permit Required? Y / N
Purpose of the space:		
Hazards Associated with Space:		

Name of Space:	Location	Permit Required? Y / N
Purpose of the space:		
Hazards Associated with Space:		

Name of Space:	Location	Permit Required? Y / N
Purpose of the space:		
Hazards Associated with Space:		

Name of Space:	Location	Permit Required? Y / N
Purpose of the space:		
Hazards Associated with Space:		

Name of Space:	Location	Permit Required? Y / N
Purpose of the space:		
Hazards Associated with Space:		

Name of Space:	Location	Permit Required? Y / N
Purpose of the space:		
Hazards Associated with Space:		

Name of Space:	Location	Permit Required? Y / N
Purpose of the space:		
Hazards Associated with Space:		



Hazard Assessment

- **Hazard Assessment Definition**

- ★ An in depth evaluation of a Confined Space to determine the hazards and classification of a space.

- **Classifications**

- ★ **Non-Permit Confined Spaces** - is a confined space that does not contain or, with respect to atmospheric hazards, have the potential to contain any hazard capable of causing serious physical harm or death.

- ★ **Permit Required Confined Space** - is a confined space that contains or, with respect to atmospheric hazards, has the potential to contain any hazard capable of causing serious physical harm or death.

- ★ Any potential atmospheric hazard should be substantiated



Confined Space Hazards

- **Physical Hazards:**

- ★ **Electrical shock hazards** (Electrical systems in the space)

- ★ **Crush hazards** (Agitator, Rotary Systems, any moving parts)

- ★ **Fall hazards/Objects** (Stairways, Vertical Rung Ladders, Floor Openings & objects falling into the space)



Confined Space Hazards

- **Physical Hazards (Continued)**

- ★ **Slip Hazards** (Bird excrement; moss; water; scum, operating Fluids)

- ★ **Engulfment** (To be surrounded and effectively captured in a liquid or a flowable particulate solid that can be aspirated and cause suffocation, strangulation, constriction, or crushing that may lead to death)

- ★ **Noise** (Exposures greater than 85 dBA 8 hour TWA)

- ★ **Temperature Extremes** (potential to cause Hypothermia or Hyperthermia)



Confined Space Hazards

- **Structural Hazards**
 - ★ Confined Space areas that may contain structural defects.
 - ★ Various bridge structures
 - ★ Confined Space Configuration
 - ★ Deteriorated culverts



Confined Space Hazards

- **Biological Hazards**

- ★ **Bacterial Action** - a process that consumes oxygen to produce carbon dioxide, hydrogen sulfide, or methane. (This may occur when vegetation is decomposing, or from bacterial growth in water and mud).

- **Chemical Process Hazards**

- ★ **Oxidation** - the process of combining or causing to combine with oxygen. (Metal rusting).



Confined Space Hazards

- **Atmospheric Hazards - Oxygen**

- ★ Oxygen content below 19.5% or above 23.5%

Dangers of Enriched Oxygen

- ★ Enriched Oxygen levels above 23.5% can increase the level of flammability as well as cause the fire to burn hotter.



Dangers of Low Oxygen Levels

■ 16 - 12% Oxygen in Air

★ Deep breathing; fast heartbeat; poor thinking; poor attention; poor coordination.

■ 14 - 10% Oxygen in Air

★ Faulty judgment; rapid fatigue that could cause heart damage; intermittent breathing; very poor coordination.

■ 10% or Less in Air

★ Nausea; vomiting; loss of movement; loss of consciousness followed by death.

■ Less than 6% in air

★ Spasmodic breathing; convulsive movement; death in minutes.



Low Oxygen Levels

- **What Causes Low Levels:**

- ★ Algae, bacteria or other organisms grow in mud, sludge, water in the confined space.
- ★ Other gases fill the space pushing oxygen out or reducing the amount of oxygen.
- ★ There is a fire or any other combustion source in the space that removes oxygen.
- ★ Rusting metal (the process of rusting removes oxygen from the air in a closed space).



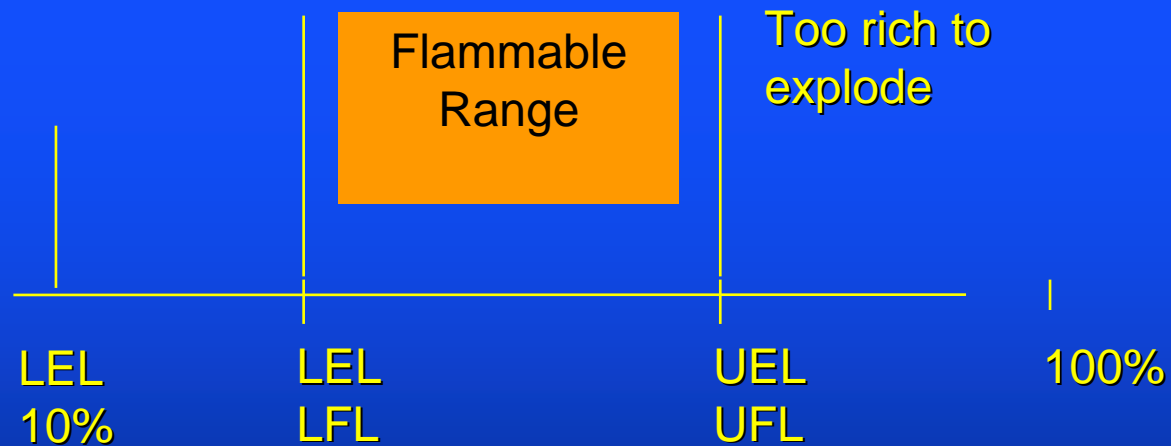
Flammable Substances in Air

- **Flammable/Explosive Gas, Vapor or Mist**
 - ★ Hazardous if exceeds 10% of the Lower Explosive Limit
- **Airborne Combustible Dust**
 - ★ Hazardous if concentration meets or exceeds its LEL
 - ✘ starches, dust, dry ingredients, saw dust, grain dust, etc.

Gas Concentrations in Air

LFL = lower flammable limit
LEL = lower explosive limit
UEL = upper explosive limit
UFL = upper flammable limit

Flammability/Explosive



Methane 0.5% 5% 15%



Hazardous Atmospheres, Toxic Vapors or Gases

★ Definitions:

- ★ **Immediately Dangerous to Life and Health** - The maximum concentration of gas in ppm, from which a worker could escape within 30 minutes without experiencing any escape-impairment or irreversible health effects.
- ★ **Part Per Million (PPM)** - A common unit of measurement for toxic gases. This term literally means one part out of one million parts. (1% = 10,000 ppm)
- ★ **Permissible Exposure Limits (PEL)** - An OSHA established level of gas in ppm, a worker can be exposed to 8 hours a day / 40 hours a week for the rest of their life with no long term health effects.



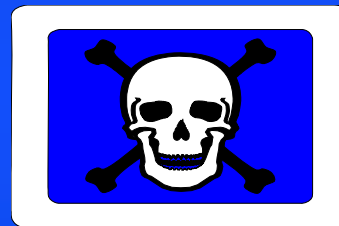
Hazardous Atmospheres, Toxic Vapors or Gases

- **Toxics created by the natural processes of organisms:**
 - ★ **Carbon dioxide**
 - ★ **Hydrogen sulfide**
 - ★ **Methane**
 - ★ **All of these toxins are byproducts of the breakdown of organic materials (urine, plants, etc.)**

Toxic Concentrations in Air

PEL = permissible exposure limit
IDLH = immediately dangerous to life
& health concentration

Toxicity



0%

OSHA PEL

IDLH

Carbon Monoxide (CO)

50 ppm

1200 ppm

Alsea Bay Bridge Concrete Box Girders

Other Considerations:

★ Bird Droppings (Psittacosis)





Initial Air Testing

- ✧ **Make sure you have appropriate personal protective equipment.**
- ✧ **Do not place yourself in danger.**
- ✧ **Test the entry and all levels in the space.**
- ✧ **Fill out Appendix B with the results as you test.**



Assessing the Air

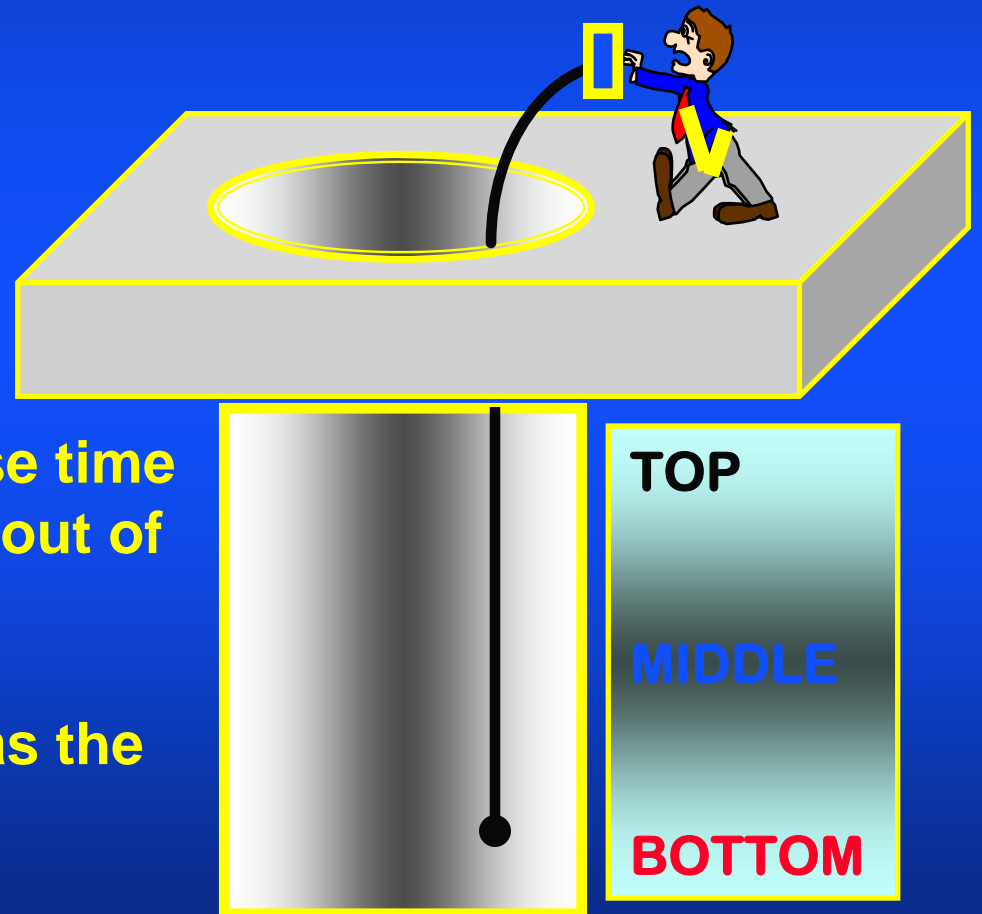
✧ Some Gases Will Stratify, such as:

- ★ Methane - lighter than air
- ★ Carbon Monoxide - same as air
- ★ Hydrogen Sulfide - heavier than air

✧ See Confined Space Atmospheric Testing Brochure for more information.

Assessing the Air

- ✓ **Sample every 3 to 4 ft**
- ✓ **Don't trust your senses**
- ✓ **Don't be rushed**
- ✓ **Know the meter response time**
- ✓ **Keep the sampling tube out of the product**
- ✓ **Periodically retest**
- ✓ **Raise tube only as fast as the meter response time**





Equipment for Air Testing

- **Types**

- ★ **Oxygen meters**

- ★ **Combustible gas meters**

- ★ **Multi-gas meters**

- **To test for specific gases, consult with your Safety Manager.**

Calibration - before each use!



PRCS - Yes or No

- **PRCS Hazard Assessment Form**

- ★ **If any of the questions are answered with:**

- ✘ **YES** - then the space is a Permit Required Confined Space and the ODOT PRCS Program Must Be Followed.

- ★ **If the response is NO to all questions, then**

- ✘ The space is a confined space but not a Permit Required Confined Space. (Safety hazards shall be controlled but the ODOT PRCS program is not needed).



Permit Entry Requirements

- 1. General PRCS Information**
- 2. Logistics and Resources**
- 3. External Hazards and Control**
- 4. Internal Hazards and Control**
- 5. Self-Created Hazards and Control**
- 6. Rescue/Emergency Procedure**
- 7. Contractors Requirements**
- 8. Termination Activities**



General PRCs Information

- ✘ **Location**
- ✘ **Description of Space**
- ✘ **Type of work to be performed**
- ✘ **Work Section**
- ✘ **Time Started**
- ✘ **Time Completed**

External Hazards and Control

- ⌘ **Labeling Space and Prevention of Entry**
 - ⌘ All PRCs's Must be Marked and Secured.
- ⌘ **Traffic Control**
 - ⌘ Vehicular & Pedestrian
- ⌘ **Slip/Fall Hazards**
 - ⌘ Using Bucket Trucks
 - ⌘ Access to the Space Entry (Stairs, Ladders, etc)
 - ⌘ Guarding of Openings
 - ⌘ Wet Floors, Bird/Bat Droppings, Rough Terrain





Internal Hazards and Control

⌘ Atmospheric/Explosion Hazards

- ⌘ Develop Air Monitoring Plan based on your hazard assessment. What, where, and when of Testing.
- ⌘ Control or manage the Atmosphere
 - ⌘ VENTILATION
 - ⌘ Local Exhaust
 - ⌘ Supplied (Dilution)



Internal Hazards and Control

✘ Fall Protection Hazards

- ✘ Any fall over 6 feet requires a fall protection plan
 - ✘ Type of Fall Protection needed
 - ✘ Fall Restraint (Guard Rail, Perimeter Barrier)
 - ✘ Fall Arrest (Nets, Harness and Lifelines)

✘ Lockout/Tagout

- ✘ Any energized system (Electrical, Pneumatic, Steam, Hydraulic, Mechanical, and Spring)
- ✘ Refer to Occupational Safety and Health Program PRO96002



Internal Hazards and Control

⌘ Drowning Hazards

- ⌘ Standing greater than 3 feet deep.
- ⌘ Moving water greater than 1 foot deep.
 - ⌘ Develop a Plan for Removing the hazard or managing the risk with PPE or other control methods.

⌘ Other Hazards

- ⌘ Bird/Bat Droppings
- ⌘ Raw Sewage
- ⌘ Wild Animals
- ⌘ Dangerous People