



MODULE 15

Permit-Required Confined Space Entry

CONFINED SPACE ENTRY





Confined Spaces

- What confined spaces exist on oil and gas well sites?
- What hazards may exist in these confined spaces?



Identifying Confined Spaces

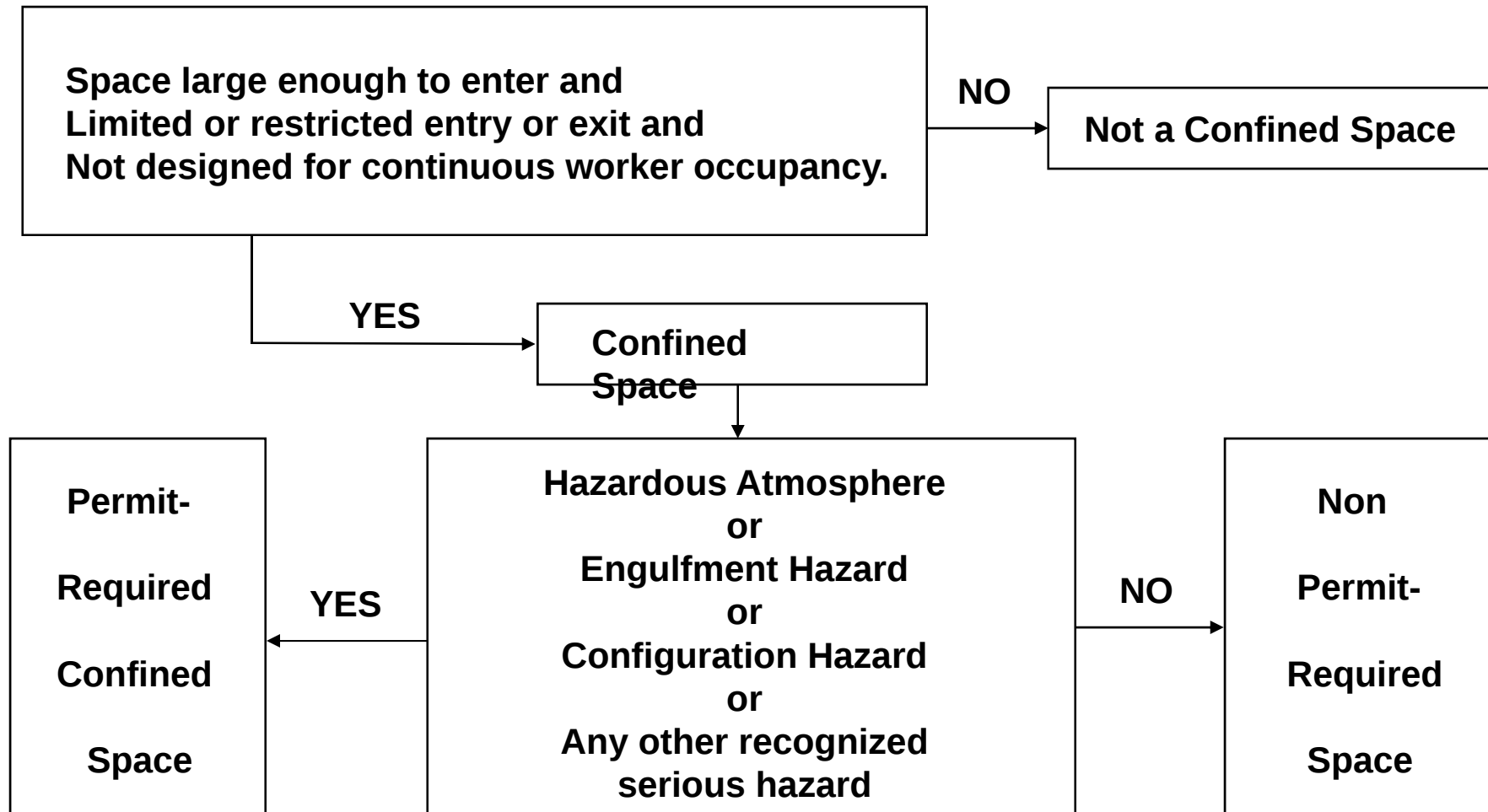
- Large Enough to Enter and Work
- Limited Openings for Entry and Exit
- Not Designed for **Continuous** Worker Occupancy







Categorizing Work Space





1910.146

Permit-Required Confined Spaces



Applicable regulations

- 29 CFR 1910.146
 - General industry only – does not apply to construction operations



(b) Definitions

Entry

- Passing through opening (any part of entrant's body breaks its plane)
- Includes ensuing work activities



(b) Definitions

Hazardous Atmosphere

1. Flammable gas, vapor, or mist in excess of 10% of its LFL
2. Airborne dust at a concentration that meets or exceeds its LFL (Rule of thumb: vision at <5')
3. Oxygen <19.5% or >23.5%
4. Atmospheric concentrations of substances above PEL
5. Other atmospheric conditions: IDLH.



(b) Definitions

Engulfment

- The surrounding & effective capture of a person by a liquid or finely divided (flammable) solid substance that can:
 - Be aspirated to cause death by filling or plugging the respiratory system
 - Exert enough force on the body to cause death by strangulation, constriction, or crushing.



Engulfment Hazards

- Loose, granular materials stored in bins and hoppers - grain, sand, coal, etc.
- Crusting and bridging below a worker
- Flooding of confined space
- Water or sewage flow



(b) Definitions

Configuration Hazard

- Has an internal configuration such that an entrant could be trapped or asphyxiated
 - By inwardly converging walls, or
 - By a floor which slopes downward & tapers to a smaller cross-section



Hazards of Confined Spaces

- Oxygen Deficient Atmospheres
- Oxygen Enriched Atmospheres
- Flammable Atmospheres
- Toxic Atmospheres
- Temperature Extremes
- Engulfment Hazards
- Equipment (machinery, electrical)



Other Hazards

- Noise
 - Amplified due to acoustics within the space
 - Damages hearing; affect communication
- Slick / Wet Surfaces
 - Slips and falls
 - Increased chance of electric shock
- Falling Objects
 - Topside openings expose workers inside confined space to falling objects



Oxygen Deficient Atmospheres

19.5 %	Minimum acceptable oxygen level.
15 - 19%	Decreased ability to work strenuously. Impaired coordination. Early symptoms.
12-14%	Respiration increases. Poor judgment.
10-12%	Respiration increases. Lips blue.
8-10%	Mental failure. Fainting. Nausea. Unconsciousness. Vomiting.
6-8%	8 minutes - fatal 6 minutes - 50% fatal 4-5 minutes - possible recovery
4-6%	Coma in 40 seconds. Death.



Oxygen Enriched Atmospheres

- Oxygen level above 23.5%
- Causes flammable and combustible materials to burn violently when ignited
 - Hair, clothing, materials, etc.
 - Oil soaked clothing and materials
- Never use pure oxygen to ventilate
- Never store or place compressed tanks in a confined space



Flammable Atmospheres

- Critical Factors:
 - Oxygen content in the air
 - Presence of a flammable gas, or vapor
 - Presence of dust (visibility of 5' or less)
- Proper air/gas mixture can lead to explosion
- Typical Ignition Sources:
 - Sparking or electric tool
 - Welding / cutting operations
 - Smoking



Toxic Atmospheres

- Product stored in a confined space:
 - Gases released when cleaning
 - Materials absorbed into walls of confined space
 - Decomposition of materials in the confined space
- Work performed in a confined space:
 - Welding, cutting, brazing, soldering
 - Painting, scraping, sanding, degreasing
 - Sealing, bonding, melting
- Areas adjacent to a confined space



Hydrogen Sulfide

- Decomposition of materials, human waste
- Naturally present in some oil/gas reservoirs
- Rotten egg odor at low concentrations
- Possibly no warning at high concentrations

PPM	Effect	Time
10	Permissible Exposure Level	8 Hours
50 - 100	Mild Irritation - eyes, throat	1 Hour
200 - 300	Significant Irritation	1 Hour
500 - 700	Unconsciousness, Death	1/2 - 1 Hour
>1000	Unconsciousness, Death	Minutes



Carbon Monoxide

- Odorless, colorless gas
- Combustion by-product
- Quickly collapse at high concentrations

PPM	Effect	Time
50	Permissible Exposure Level	8 Hours
200	Slight headache, discomfort	3 Hours
600	Headache, discomfort	1 Hour
1000-2000	Confusion, nausea, headache	2 Hours
1000-2000	Tendency to stagger	1 1/2 Hours
1000-2000	Slight heart palpitation	30 Min.
2000-2500	Unconsciousness	30 Min.



Temperature Extremes

- Extreme heat & cold
- Steam cleaning
- Humidity factors
- Extremely cold liquids
- Work processes inside the confined space can increase temperature extremes
- Personal protective equipment



29 CFR 1910.146(c)

General Requirements



1910.146(c) General Requirements

1. Employer shall evaluate workplace
2. If workplace contains permit spaces, signs shall be posted
 - Give notice of
 - Existence
 - Location
 - Danger
3. Effective measures shall be taken to prevent entry if not allowed



1910.146(c) General Requirements

4. If entry is allowed, a permit space program must be:
 - Written
 - Implemented
 - Made available to employees/representatives



1910.146(c)(5) Alternate procedures

- Compliance may be simplified (paragraphs (d)-(f) and (h)-(k) exempted) if:
 - Can demonstrate that the only hazard is atmospheric
 - Can demonstrate that continuous forced air ventilation can control the hazard
 - Supportive monitoring & inspection data is developed



1910.146(c)(5) Alternate procedures

- Compliance may be simplified (paragraphs (d)-(f) and (h)-(k) exempted) if:
 - Entry to obtain initial supportive data is made in full compliance
 - Qualifying info of (A)-(C) above is shared with each entrant
 - Further entries are made in compliance with (c)(5)(ii)





1910.146(c)(5) Alternate procedures

- ii. Simplified compliance requirements are:
 - A. It must be safe to remove the entrance cover
 - B. Open entrance covers must be promptly guarded
 - Railing or temporary cover/ barrier



1910.146(c)(5) Alternate procedures

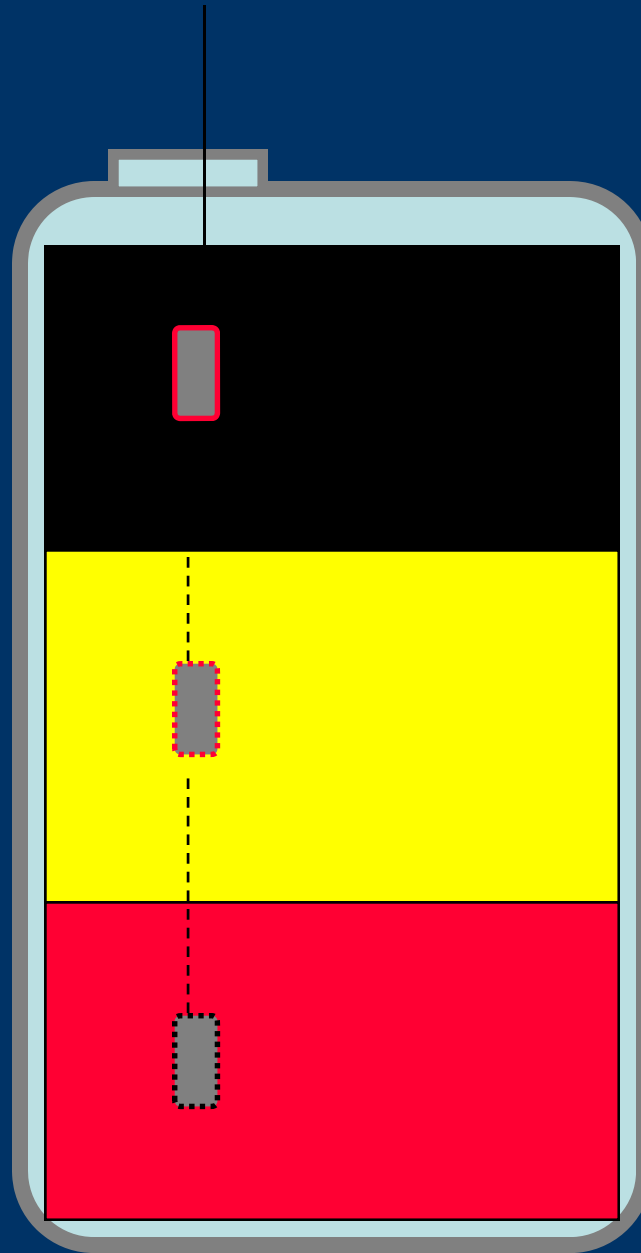
ii. Simplified compliance requirements are:

C. Prior to entry, the internal atmosphere shall be tested for:

- Oxygen content
- Flammable gases & vapors
- Potential toxic air contaminants
- **In that order!**
- Entrant/representative must be allowed to observe pre-entry testing

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



Order of Testing

- First---Oxygen Presence And Amounts
- Second---Flammables
- Third---Toxics
- Others





1910.146(c)(5) Alternate procedures

- ii. Simplified compliance requirements are:
 - D. No hazardous atmosphere allowed whenever any employee is inside the space
 - E. Continuous forced air ventilation
 - F. Periodic testing as necessary, observable by entrant/representative



1910.146(c)(5) Alternate procedures

ii. Simplified compliance requirements are:

G. If hazardous atmosphere is detected during entry:

1. Employees out immediately
2. Hazard evaluated
3. Protective measures implemented



1910.146(c)(5) Alternate procedures

ii. Simplified compliance requirements are:

H. Certification requirements:

- Written
- Space safe to enter (verified)
- Pre-entry measures taken (verified)
- Date
- Location of the space
- Signature of certifier
- Available to entrant/representative



Common Air Monitoring Errors

- No correlation between O₂ and LEL
- Test it and forget it
- Lack of training
- Misinterpretation of readings and data
- Weak internal standards



1910.146(c) Reclassification

6. Reclassification: non-permit to permit
 - Where changes in use or configuration might increase the hazards
7. Reclassification: permit to non-permit
 - i. When atmospheric hazards are not present, or while they remain eliminated
 - ii. Entry to determine this must be made in full compliance



1910.146(c)(8) Host Employers

- A **host** employer arranging for employees of a **contractor** employer to perform work shall inform about:
 - i. Permit spaces & program
 - ii. Identified hazards
 - iii. Precautions/procedures
 - iv. Entry operations (& coordinate them)
 - v. Entries completed & hazards found



1910.146(c)(9) Contractors

- Contractor employer shall interact with host employer to:
 - i. Obtain info about hazards & entry operations
 - ii. Coordinate entry operations
 - iii. Inform about program followed & any hazards confronted or created



1910.146(d) Permit-required confined space program

1. Implement measures to prevent unauthorized entry
2. Identify & evaluate hazards prior to entry



1910.146(d) Permit-required confined space program

3. Develop & implement means, procedures & practices for safe entry:
 - i. Specify acceptable entry conditions
 - ii. Let entrant/rep observe monitoring/testing
 - iii. Isolate the permit space
 - iv. Purge, inert, flush or ventilate as necessary
 - v. Provide barriers
 - vi. Verify acceptable conditions throughout entry



1910.146(d) Permit-required confined space program

4. Provide the following equipment at no cost to the employee:
 - i. Testing & monitoring equipment
 - ii. Ventilation equipment
 - iii. Communication equipment
 - iv. PPE
 - v. Lighting equipment
 - vi. Barriers & shields
 - vii. Ingress/egress equipment (ladders, etc.)
 - viii. Rescue & emergency equipment
 - ix. Other needed entry/rescue equipment



1910.146(d) Permit-required confined space program

5. Evaluate permit space to ensure acceptable conditions
6. Provide at least one attendant
7. Provide means & procedures for emergency response to two spaces if monitored by one attendant
8. Designate program personnel & duties and provide training



1910.146(d) Permit-required confined space program

9. Develop & implement procedures for rescue and emergency services
10. Develop & implement a system for entry permits
 - preparation
 - issuance
 - use
 - cancellation



1910.146(d) Permit-required confined space program

- 13. Develop & implement procedures to coordinate multi-employer entry operations
- 14. Develop procedures for concluding entry operations
- 15. Review entry operations when protective measures appear insufficient
- 16. Review program at least annually, using retained cancelled permits



1910.146(e) Permit system

1. Entry permit completed by employer authorizes entry
 - Documents completion of entry measures required by 1910.146(d)(3)
2. Supervisor's signature authorizes entry
3. Posted permit provides assurance to entrants/rep's of completed pre-entry prep's
4. Duration of permit may not exceed time needed to complete assigned task



1910.146(e) Permit system

5. Entry supervisor terminates entry & cancels permit when:
 - i. The entry operation covered by the permit has been completed; or
 - ii. A condition that is not allowed under the entry permit arises in or near the permit space.
6. Cancelled permits are retained for at least 1 year
 - problems must be noted & evaluated



1910.146(f) Entry permit

- Space to be entered, purpose, date & duration
- Names of attendants and supervisor
- Hazards of space
- Measures to isolate space & control hazards
- Acceptable entry conditions
- Test results, initial and periodic
- Rescue and emergency services
- Communication procedures
- Equipment
- Other information
- **Other permits**, such as hot work

Example of 1 page permit

CONFINED SPACE ENTRY PERMIT

ALL COPIES OF PERMIT WILL REMAIN AT JOB SITE UNTIL JOB IS COMPLETED.

LOCATION/DESCRIPTION OF CONFINED SPACE _____ DATE _____

PURPOSE OF ENTRY _____ TIME _____

DEPARTMENT _____ PERSON IN CHARGE OF WORK _____ EXPIRATION _____

COMMUNICATIONS:

SUPERVISOR(S) In Charge of Crews	Type of Crew	Phone

SPECIAL REQUIREMENTS:

	YES	NO		YES	NO
Lockout De-energize			Escape Harness Required		
Lines Broken - Capped or Blanked			Tripod Emergency Escape Unit		
Purge - Flush and Vent			Lifelines		
Ventilation			Fire Extinguishers		
Secure Area			Lighting		
Breathing Apparatus			Protective Clothing		
Resuscitator - Inhalator			Respirator		

TEST(S) TO BE TAKEN

(VALID FOR ONE 8 HOUR TURN ONLY)	P.E.L.*	YES	NO	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date	Date
				M	M	M	M	M	M	M	M	M	M	M
% of Oxygen	-19.5% +21%													
% of L.E.L.*	Any % over 10%													
Carbon Monoxide	50 ppm													
Aromatic Hydrocarbon	10 ppm													
Hydrocyanic Acid	10 ppm													
Hydrogen Sulfide	10 ppm													
Sulfur Dioxide	5 ppm													
Ammonia	25 ppm													

NAME OF GAS TESTER _____

NOTE: Continuous/periodic tests shall be established before beginning the job.
Any questions pertaining to test requirements should be directed to _____

TESTING INSTRUMENTS USED	NAME	TYPE	IDENTIFICATION NO.

AUTHORIZED ENTRANTS: _____ AUTHORIZED ATTENDANTS: _____

PERMIT AUTHORIZATION:

I certify that all actions and conditions necessary for safe entry have been performed.

NAME (Print) _____ SIGNATURE _____

DATE _____ TIME _____

*P.E.L. Permissible Entry Level
*L.E.L. Lower Explosion Level

FIRE CALL _____ AMBULANCE CALL _____ RESCUE CALL _____



1910.146(g) Training

2. (2) Training shall be provided:
 - i. Before first assigned duties
 - ii. Before change in duties
 - iii. When permit space requirements change
 - iv. When employee seems not to have retained previous training



Confined space rescue training exercise



1910.146(h) Duties of Authorized Entrants

- Know hazards and symptoms
- Use equipment properly
- Communicate with attendant
- Alert attendants of symptoms or prohibited condition
- Exit as quickly as possible after:
 - Attendant or supervisor give order to evacuate
 - Recognizing sign or symptom of exposure
 - Detecting prohibited condition
 - Evacuation alarm is activated



1910.146(i) Duties of Attendants

- Know hazards, symptoms & behavioral effects
- Count, monitor, communicate with & protect personnel
- Stay posted outside space until released
- Summon rescue/emergency services
- Warn unauthorized persons to stay away or exit; inform others if present in space
- Non-entry rescue
- No other interfering duties



1910.146(j) Duties of Entry Supervisors

- Know hazards, symptoms & behavioral effects
- Verify permit conditions
- Authorize & terminate entries
- Verify rescue availability
- Remove unauthorized persons
- Ensure compliance with terms of entry permits



1910.146(k) Rescue & Emergency Services

1. Employer shall:

- Evaluate a prospective rescuer's timely response according to hazards
- Evaluate prospective rescue service's ability for pertinent types of rescue
- Select a rescue service based on those criteria
- Inform rescue service of potential hazards
- Provide rescue service with access to permit spaces to
 - develop appropriate plans
 - practice rescue operations



1910.146(k) Rescue & Emergency Services

2. Rescue service employer shall:
 - i. Provide PPE at no cost to employees.
 - ii. Train affected employees to perform assigned rescue duties
 - iii. Train in First Aid/CPR
 - iv. Practice making permit required rescue at least every 12 months



1910.146(k) Rescue & Emergency Services

3. Retrieval systems for non-entry rescue

- Authorized entrant shall use a chest or full body harness with retrieval line
- Other end of line connected to make quick rescue possible



1910.146(l) Employee Participation

- Employers shall consult with affected employees/ reps on all aspects of permit space program required in 1910.146(c)
- Employer shall make available to affected employees/rep all information required to be developed by this section



Test Your Knowledge

- What are the 3 characteristics of a confined space?
- At what levels does oxygen become: Deficient?
Enriched?
- What is the maximum duration of a space permit?
- General requirements of a space permit program are: written, implemented and ?
- Large Enough to Enter and Work
Limited Openings for Entry and Exit
Not Designed for Continuous Worker Occupancy
- 19.5%
23.5%
- The time needed to complete the assigned task
- Made available to affected employees or their designated representatives