Collaborative Bachelor's Degree Program of Fire Protection and Safety Engineering Technology between Southwest Jiaotong University and Oklahoma State University, U.S.A.

FPST 2023 Industrial and Occupational Safety

Permit-Required Confined Spaces

1

Objectives

- Define and identify confined spaces
- Define and identify permit-required confined spaces
- Understand hazards associated with permit-required confined spaces
- Understand permit-required confined space entry requirements

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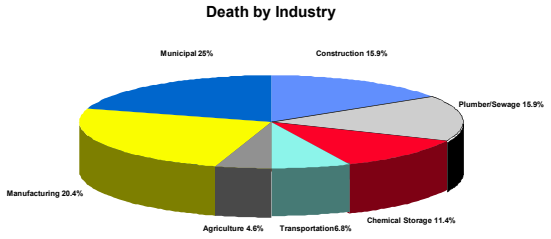
Confined Spaces



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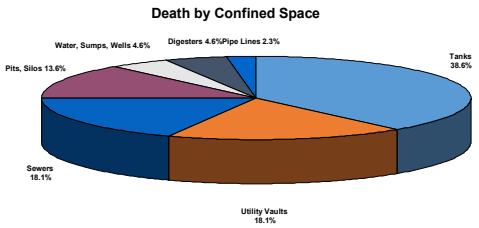
Confined Spaces



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Causes of confined space fatalities

- Hazardous atmospheres (65%)
- Engulfment (13%)
- Struck by falling objects (7%)
- Heat stress/exposure (6%)
- Electrocution (5%)

Source: OSHA

5

Types of Confined Spaces

- Confined spaces can be generally categorized in two major groups:
  - Those with open tops and a depth that restricts the natural movement of air
  - Enclosed spaces with very limited openings for entry

- Process vessels
- Septic tanks
- Wastewater digester
- Pumping and lifting stations
- Silos
- Vats
- Ducts
- Utility vaults
- Boilers
- Pipelines
- Open-top spaces of depths more than 5 feet

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Types of Confined Spaces

- Degreasers, pits, and certain types of storage tanks may be classified as open-top confined spaces that usually contain no moving parts

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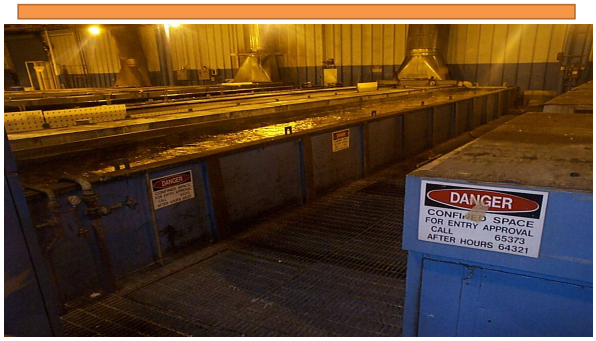

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Pit Type Tubular Turbines

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Types of Confined Spaces

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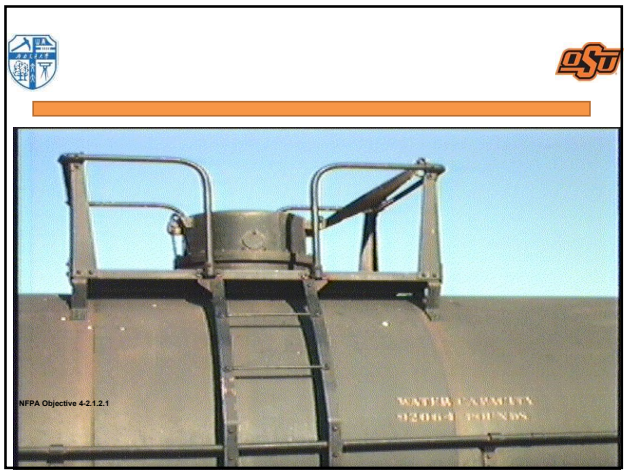

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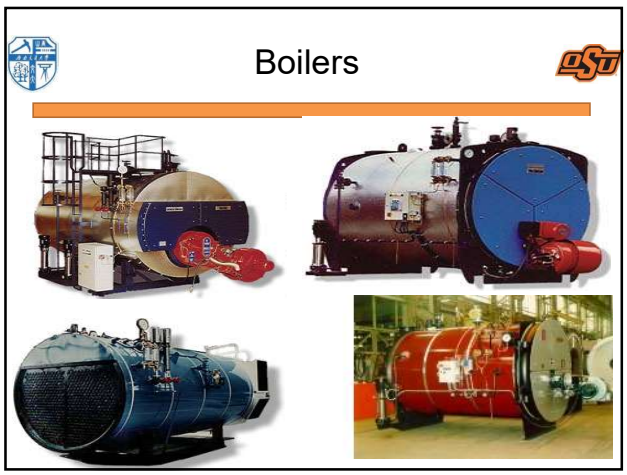
Boilers



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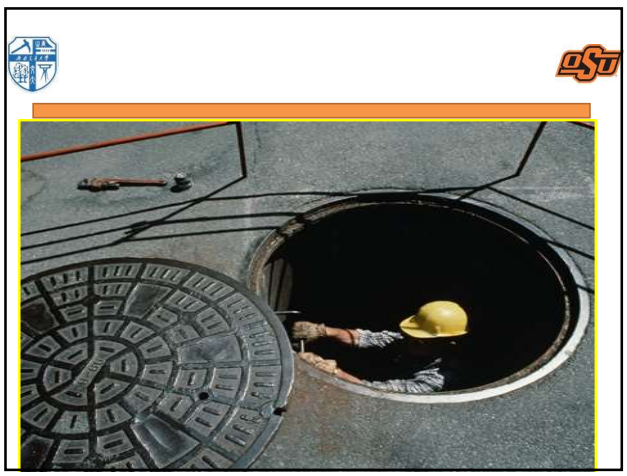

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16

CONFINED SPACES

17

Confined Space Identification

- Confined space means a space that:
  1) Is large enough and so configured that an employee can bodily enter and perform assigned





18

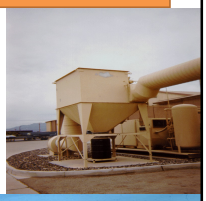
Spaces Too Small to Enter

- "While OSHA is concerned that spaces that are too small for complete bodily entry may pose hazards for employees, the Agency did not intend to cover such spaces under the permit space standard."
  - (FR 1/4/93, p. 4477)

19

Confined Space Identification

2) Has limited or restricted means for entry or exit (for example, tanks, vessels, silos, storage bins, hoppers, vaults, and pits are spaces that may have limited means of entry)



20

Federal Register Nov. 4, 1994

- "For example, even if the door or portal of a space is of sufficient size, obstructions could make entry into or exit from the space difficult
- The Agency intended that spaces which otherwise meet the definition of confined spaces, and which have obstructed entry or exits even though the portal is a standard size doorway, be classified as confined spaces."
  - CPL 2.100, pgs. E-3 and E-4
  - https://www.osha.gov/sites/default/files/enforcement/directives/CPL_02-00-100.pdf

21

Confined Space Identification

3) Is not designed for continuous employee occupancy

22

Not Designed for Continuous Employee Occupancy

- Continuous human occupancy does not mean that the space must be perpetually occupied
- It means that the space could be occupied continuously under normal operating conditions
  - An example would be a vented telecommunications vault
  - OSHA's guidance
    - "However, using a vented telecommunications vault as an example, OSHA has described factors that employers may consider in determining whether a space is designed for continuous employee occupancy, such as ventilation ensuring the presence of a normal atmosphere for an occupant to breathe, and working dimensions large enough to allow an adult to work and move around while standing erect."
      - (FR 1/14/1993, p. 4478)

23

PERMIT-REQUIRED CONFINED SPACES

24

Conditions

- A permit-required confined space has one or more of the following characteristics:
  - Contains or has the potential to contain a hazardous atmosphere;
  - Contains a material that has the potential to engulf an entrant;
  - Has walls that converge inward or floors that slope downward and taper into a smaller area which could trap or asphyxiate an entrant; **or**
  - Contains any other recognized safety or health hazard, such as unguarded machinery, exposed live wires, or heat stress.

25

Conditions

- Atmospheric hazards are described as:
  - Oxygen-deficient atmospheres – an atmosphere that has less than 19.5% available oxygen; it presents a risk of asphyxiation
  - Flammable atmospheres – has oxygen in the air (risk increases when oxygen concentration is >23%) and flammable gas, vapor, or dust in the proper mixture
  - Toxic atmospheres – most substances (liquids, vapors, gases, mists, solid materials, and dusts) should be considered hazardous in a confined space.

26

27

- Atmospheric hazards occur when there is a lack of natural air movement

28

Confined Space Hazards

- Engulfing hazards
  - Person is surrounded and effectively captured by liquid or finely divided (flowable) solid substance
    - Grain engulfment in storage bins

Source: OSHA

29

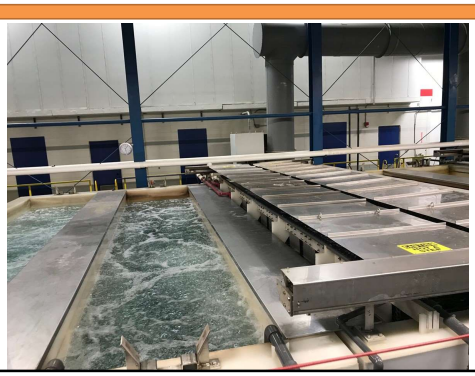
Confined Space Hazards

Source: OSHA

- Examples of engulfing hazards
  - Soil cave-ins in excavations
  - Sand engulfment in foundry bins
  - Coal engulfment in hopper or bin
  - Flooding of confined space
  - Water or sewage flow

30

Engulfment Potential?



31

Space Configuration

- Space configuration hazards include:
  - Crawling through spaces such as tubes that bend in ways the human body doesn't bend
  - Getting stuck because of being unable to climb out of a structure with sloping walls
  - Pipes, conduits, ducts, or other equipment or materials that require an employee to crawl over or under or squeeze through in order to escape

32

Other Hazards

- Examples of other hazards include:
  - Failure to control mechanical or electrical energy during service or maintenance work
  - High voltage, standing liquids, slippery surfaces, or moving machinery
  - Extreme temperatures
  - High noise levels
  - Grinding, crushing, or mixing mechanisms
  - Inadequate lighting
  - Animals inhabiting the space – insects, rodents, snakes, reptiles, or other vermin
  - Disease pathogens
  - Radiation, light level, or temperature extreme
  - Depth or length of space

33

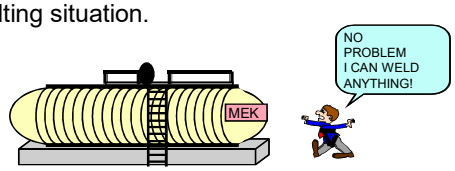
Common Factors in Confined Space Fatalities

- Why do people die in confined spaces?
  - They do not recognize a confined space when they see one
  - They simply do not know that the space can be dangerous
  - Unaware of the potential hazard
  - Employees are uneducated of the potential hazard

34

Common Factors in Confined Space Fatalities

- They trust their senses
  - They think that if a space looks safe, and they don't smell anything unusual, that it is safe!
- Employees are poorly equipped to manage the resulting situation.



35

Common Factors in Confined Space Fatalities

- Most hazardous atmospheres are invisible
  - They are colorless, odorless and tasteless
- Most people underestimate the danger
  - They think they can get in and out before a hazard affects them
  - They do not realize how quickly they can be overcome by a deadly atmosphere.

36

Common Factors in Confined Space Fatalities

- They do not stay on guard (complacency)
  - They forget that a hazard may develop after they have entered a space
- They try to rescue other people
- Untrained rescuers usually die along with the victim they are trying to save.

37

DRILLING RIG BALLAST TANK INCIDENT

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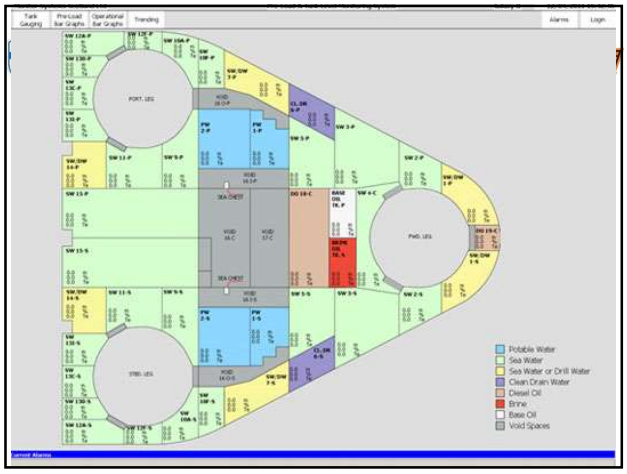

Potable Water
Sea Water
Sea Water or Drill Water
Clean Drain Water
Diesel Oil
Brine
Base Oil
Void Spaces

41

42

43

ENTRY REQUIREMENTS FOR PERMIT-REQUIRED CONFINED SPACES

44

1910.146 – Permit-Required Confined Spaces

- a – Scope and application
- b – Definitions
- c – General requirements
- d – Permit-required confined space program
- e – Permit system
- f – Entry permit
- g – Training
- h, i, j - Duties of authorized entrants, attendants, entry supervisors
- k – Rescue and emergency services.

45

1910.146 – Permit-Required Confined Spaces

- (a) Scope and application
  - This section contains requirements for practices and procedures to protect employees in general industry from the hazards of entry into permit-required confined spaces
  - Does not apply to agriculture, construction, or shipyard employment (Parts 1928, 1926, and 1915 of this chapter, respectively)

46

Procedures and Requirements

- 1910.146(c) General requirements
- 1910.146(c)(1)
  - Evaluate the workplace to determine if any spaces are permit-required confined spaces.

47

- (c)(2)
  - If the workplace contains permit spaces, the employer shall inform exposed employees, by posting danger signs or by any other equally effective means, of the existence and location of and the danger posed by the permit spaces.

- NOTE: A sign reading DANGER -- PERMIT-REQUIRED CONFINED SPACE, DO NOT ENTER or using other similar language would satisfy the requirement for a sign.

48

General Requirements

- 1910.146(c)(4)
  - If employees are expected to enter permit spaces, the employer must develop and implement a written permit space program and make it available to employees or their representatives.

49

Alternate Entry Procedures

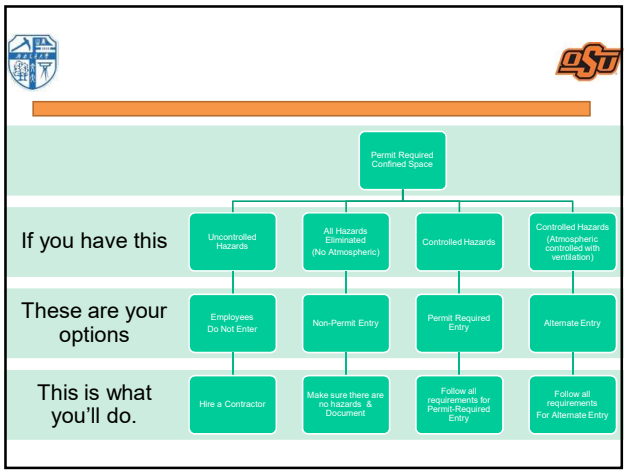
- 1910.146(c)(5)
  - Not comply with paragraphs (d) through (f) and (h) through (k) of this section if:
  - **Only** hazard posed is an actual or potential hazardous atmosphere
  - Continuous forced air ventilation alone is sufficient to maintain that permit space safe for entry
  - Monitoring and inspection data supports the previous two and is documented
  - Follow entry requirements in (c)(5)(ii)
  - Comply with (d) through (k) if an initial entry of the permit space is necessary to obtain the data.

50

Permit-Required Confined Space Reclassification to Non-Permit

- 1910.146(c)(7)
  - Reclassification procedures:
    - Space poses no actual or potential atmospheric hazards and all hazards within the space are eliminated without entry
    - Non-atmospheric hazards must remain eliminated
    - Comply with (d) through (k) if an initial entry of the permit space is necessary to eliminate the hazards
      - NOTE: Control of atmospheric hazards through forced air ventilation does not constitute elimination of the hazards. Follow alternate procedures.
    - Document the basis for determining that all hazards in a permit space have been eliminated, through a certification that contains the date, the location of the space, and the signature of the person making the determination. Make available to employees
    - If hazards arise during entry, exit the space and reevaluate.

51



52

What is the difference?

- Permit Required Confined Space Entry
  - Written Program
  - Permit required for entry
  - Entrance Guarded - Attendant
  - Atmospheric Testing – Pre-Entry
    - O2, Flammable Gas, Toxicity
    - No IDLH
  - Rescue Team on standby
  - Entrants must be tied off
- Non-Permit – Alternate Entry
  - Marked with Sign
  - All hazards eliminated
    - LOTO
  - Entrance Guarded
  - Atmospheric Testing – Pre-Entry
    - O2, Flammable Gas, Toxicity
  - Forced Ventilation
  - Training requried
  - Attendant not required (but a good idea)
  - Rescue team not required

53

Rescue

- 60% of fatalities were workers attempting to rescue other workers
- Train to follow established emergency procedures and use appropriate equipment and techniques
- Should be well-planned and practiced
  - 1910.146 App F - Non-Mandatory Appendix F -- Rescue Team or Rescue Service Evaluation Criteria
- Non-entry rescue/retrieval

Watch Video: Permit Required Confined Space Rescue

Watch Video: No Escape - Dangers of Permit-Required Confined Spaces

54

What's the difference?

55

Rescue Teams

- If you designate personnel for rescue and emergency services:
  - Evaluate rescuer's ability to respond in a timely manner;
  - Evaluate proficiency with rescue-related tasks and equipment;
  - Select a rescue team or service capable of reaching victim within an appropriate time frame;
  - Equipped for and proficient in performing the needed rescue services;
  - Informed of the hazards they may confront when called on to perform rescue at the site; and
  - Ensure access to all permit spaces from which rescue may be necessary to develop appropriate rescue plans and practice rescue operations.

56

"Timely"

- 1910.146 LOI
  - https://www.osha.gov/laws-regs/standardinterpretations/2008-05-23-0
  - "The employer must evaluate and select an off-site rescue service that has the capability to respond in a timely manner to the particular hazards at issue and to the types of emergencies that may arise in the employer's confined spaces. The criteria employers can use in evaluating and selecting a service include **determining whether the service is unavailable at certain times of the day** or in certain situations, the likelihood that key personnel of the rescue service might be unavailable at times, and, if the rescue service becomes unavailable while an entry is underway, whether the service has the capability of notifying the employer so that the employer can instruct the attendant to abort the entry immediately.
  - Compliance may require the employer to be in close communication with the off-site rescue service immediately prior to each permit space entry. In the scenario you describe, the employer must **ensure close communication with the rescue service during entry operations so that if the rescue service becomes unavailable while an entry is underway, the employer can instruct the attendant to abort the entry immediately**. Entry operations cannot resume until the entry supervisor verifies that rescue services are able to respond in a timely manner."

57

Rescue Procedures and Requirements

- Respond in timely manner
- Receive authorized entrant training
- Trained in CPR and first-aid
- Practice rescues annually.

58

Common Mistakes in Confined Space

- Failure to identify all confined spaces and perform hazard assessments
- Failure to provide training to workers
- Failure to utilize properly functioning, calibrated monitoring equipment
- Failure to monitor stratified levels of a confined space for changes in atmosphere
- The employer named a local fire department as the off-premises rescue service but had no written contract or on-site practice drills to support their contention.
- Failure to identify changing conditions in the space and taking action
- Incorrectly re-classifying the space as a non-permit space at the outset in order to avoid the costly requirements of rescue section (k)
- Reclassification of a permit space to non-permit when they had not truly eliminated all hazards through isolation of the space.

59