

# Confined Spaces

## Hazards and Controls in Construction



Brian Holmes

CM 598 Data Driven Health and Safety in Construction



# BACKGROUND DATA

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- > From 2005 to 2009, 481 fatalities occurred during work in confined spaces
  - Average of 96.5 deaths per year
- > 61% of these fatal incidents occurred during construction, repair or cleaning activities
- > 203 of 481 had worked regularly in the construction industry



# CONFINED SPACE CHARACTERISTICS

- > Limited access for entry and exit
- > Unfavorable natural ventilation
- > Not designed for continuous worker occupancy



# POTENTIAL CONFINED SPACES ON A CONSTRUCTION SITE

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- > Storage tanks
- > Pipelines
- > Silos
- > Manholes
- > Crawlspace
- > Utility vaults
- > Sewers
- > Access shafts
- > Trenches/excavations
- > Shipping/storage containers

“Unlike most general industry worksites, construction sites are continually evolving, with the number and characteristics of confined spaces changing as work progresses. “

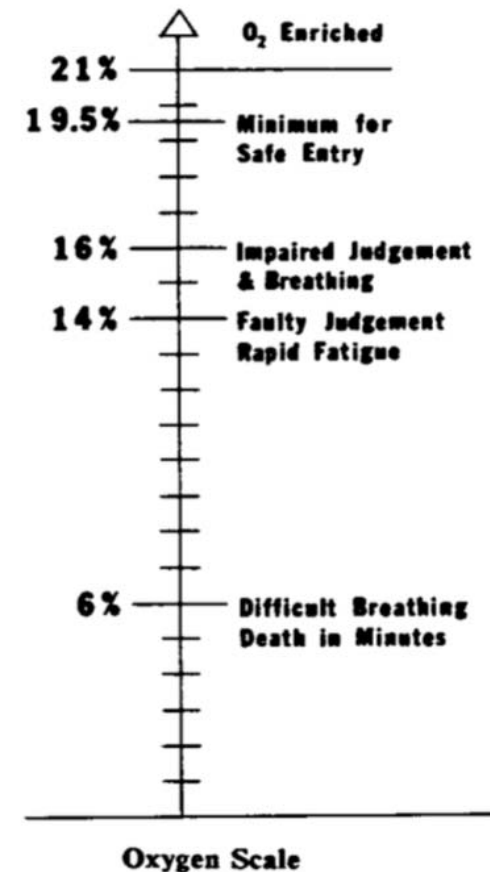
*-Assistant Secretary of Labor for Occupational Safety and Health, Dr. David Michaels*



# HAZARDS OF WORKING IN CONFINED SPACES

- > Atmospheric Hazards
  - Deficient or excessive oxygen
  - Flammable gas, vapor or dust
  - Toxic gases

CHARACTERISTICS		
CLASS A	CLASS B	CLASS C
Immediately dangerous to life	Dangerous, but not immediately life threatening	Potential hazard
OXYGEN		
CLASS A	CLASS B	CLASS C
16% or less 25% or greater	16.1% to 19.4% 21.5% to 25%	19.4% to 21.4%
FLAMMABILITY CHARACTERISTICS		
CLASS A	CLASS B	CLASS C
20% or greater of LFL	10-19% of LFL	10% of LFL or less
TOXICITY		
CLASS A	CLASS B	CLASS C
Immediately dangerous to life or health	Greater than contamination level referenced in 29 CFR Part 1910, Subpart Z	Less than contamination level referenced in 29 CFR Part 1910 Subpart Z



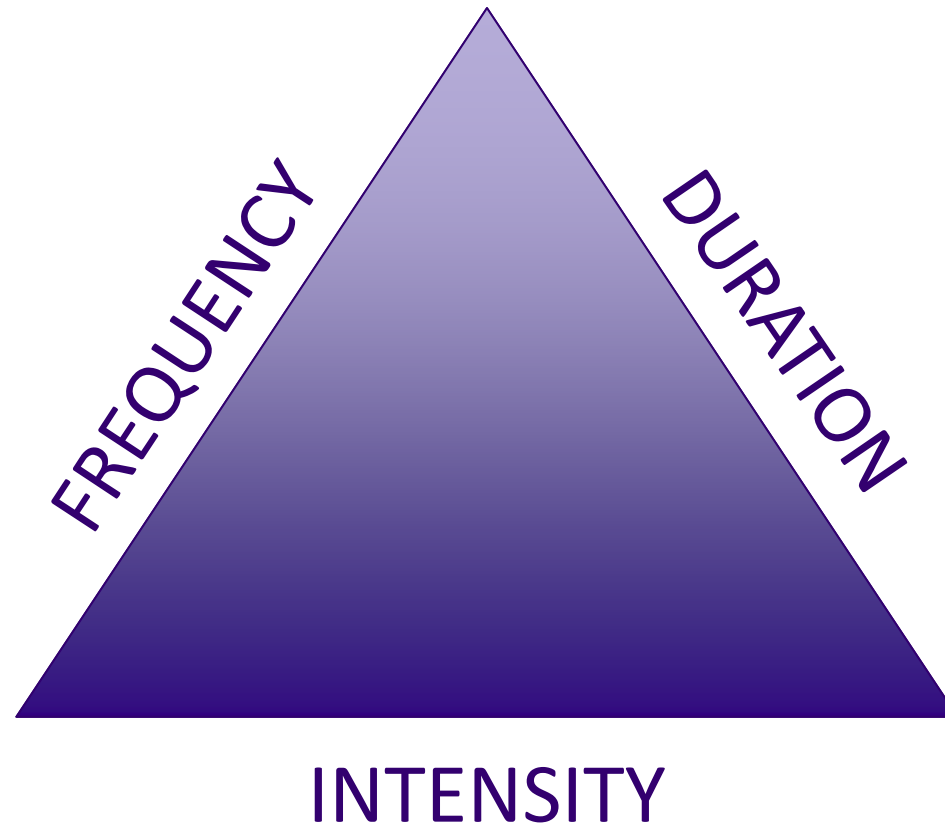
# HAZARDS OF WORKING IN CONFINED SPACES

## > Physical Hazards

- Engulfment
- Electrical/Mechanical/Hydraulic energy
- Movement of material
- Extremely high or low temperature
- Excessive noise



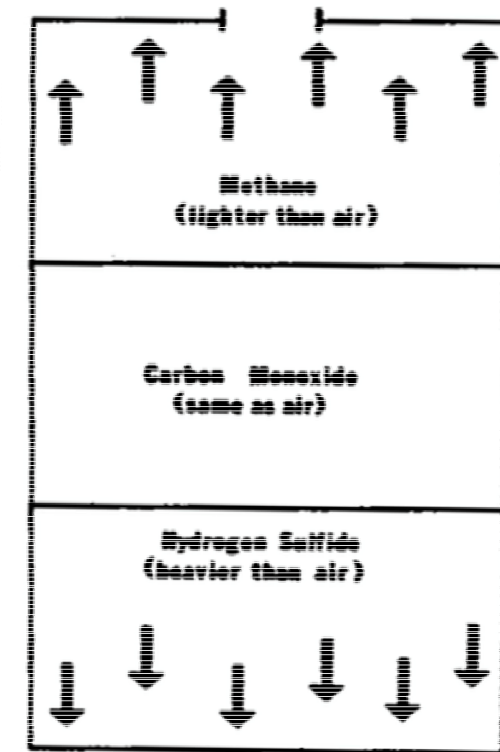
# QUANTIFYING EXPOSURE



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# MONITORING SAFETY AND HEALTH ISSUES

- > Anticipating and identifying confined spaces
  - Software tools
    - > Virtual Construction
    - > BIM
    - > 4D/5D modeling
- > Hazard analysis specific to each confined space
- > Atmospheric testing and monitoring
  - Top, middle and bottom
  - Continuous vs. periodic sampling

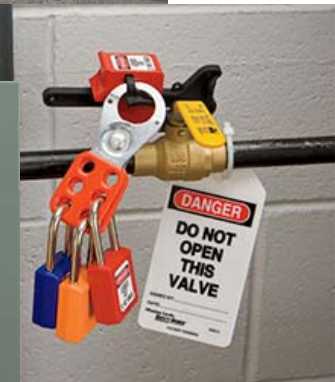




# RISK CONTROLS

## > Engineering Controls

- Forced Ventilation
- Isolation of electrical, mechanical and hydraulic energy sources
- Excavation support and stabilization
  - > Sloping/Benching
  - > Shoring
  - > Trench boxes



# RISK CONTROLS

- Excavation support and stabilization
  - > Sloping/Benching
  - > Shoring
  - > Trench boxes



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# RISK CONTROLS

**RECOMMENDATIONS FOR SAFE ENTRY: A CHECKLIST**

Use the following checklist to evaluate the confined space.

**DO NOT ENTER A CONFINED SPACE UNTIL YOU HAVE CONSIDERED EVERY QUESTION, AND HAVE DETERMINED THE SPACE TO BE SAFE.**

**YES NO**

Is entry necessary?

**TESTING**

Are the instruments used in atmospheric testing properly calibrated?

Was the atmosphere in the confined space tested?

Was Oxygen at least 19.5% - not more than 23.5%?

Were toxic, flammable, or oxygen-displacing gases/vapors present?

- Hydrogen Sulfide  
- Carbon Monoxide  
- Methane  
- Carbon Dioxide  
- Other (list) \_\_\_\_\_

**YES NO**

Can you get through the opening with a respirator on? (If you don't know, find out before you try to enter.)

**TRAINING**

Have you been trained in proper use of a respirator?

Have you received first aid/CPR training?

Have you been trained in confined space entry and rescue? (If so, specify: \_\_\_\_\_)

**STANDBY/RESCUE**

Will there be a standby person on the outside with constant visual or auditory communication with a person on the inside?

Will the standby person be able to see and/or hear the person inside at all times?

Has the standby person(s) been trained in rescue procedures?

Will safety lines and harness be required for the person?

Are company rescue procedures available to be followed in the event of an emergency?

Are you familiar with emergency rescue procedures?

Do you know who to notify and how in the event of an emergency?

**YES NO**

**ISOLATION**

Has the space been isolated from other systems?

Has electrical equipment been locked out?

Have disconnects been used where possible?

Has mechanical equipment been blocked, chocked and disengaged where necessary?

Have lines under pressure been blanked and bled?

**CLOTHING/EQUIPMENT**

Is special clothing required (boots, chemical suits, glasses, etc.)?  
(If so, specify: \_\_\_\_\_)

Is special equipment required (e.g., rescue equipment, communications equipment, etc.)?  
(If so, specify: \_\_\_\_\_)

Are special tools required (e.g., sparkproof)?  
(If so, specify: \_\_\_\_\_)

**RESPIRATORY PROTECTION**

Are MSHA/NIOSH-approved respirators of the type required available at the worksite?

Is respiratory protection required (e.g., air-purifying supplied air, self-contained breathing apparatus, etc.)?  
(If so, specify type: \_\_\_\_\_)

**YES NO**

**MONITORING**

Will the atmosphere in the space be monitored while work is going on?

Continuously?

Periodically? (If yes, give interval: \_\_\_\_\_)

**REMEMBER - ATMOSPHERIC CHANGES OCCUR DUE TO THE WORK PROCEDURE OR THE PRODUCT STORED. THE ATMOSPHERE MAY BE SAFE WHEN YOU ENTER, BUT CAN CHANGE VERY QUICKLY.**

**CLEANING**

Has the space been cleaned before entry is made?

Was the space steamed?

If so, was it allowed to cool?

**VENTILATION**

Has the space been ventilated before entry?

Will ventilation be continued during entry?

Is the air intake for the ventilation system located in an area that is free of combustible dusts and vapors and toxic substances?

If atmosphere was found unacceptable and then ventilated, was it re-tested before entry?

## > Administrative Controls

- Confined space entry procedures
- Standby/rescue spotters
- Rescue planning and rehearsal





# RISK CONTROLS

## > Personal Protective Equipment

- Respirators
  - > Air-purifying vs. air-supplying
- Training and fit-testing
- Adequate supply to carry out rescue



Half Mask,  
Particulate



Half Mask,  
Dual Cartridge  
Disposable



Half Mask,  
Dual Cartridge  
Reusable



Self Contained Breathing Apparatus (SCBA)



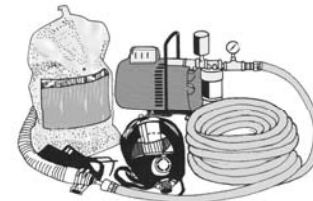
Full-Face  
Dual Cartridge  
Reusable



Canister Type  
Gas Mask



Powered air Purifying  
Respirator (PAPR)



Continuous Flow Supplied Air Respirator



QUESTIONS?



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