

# CONFINED SPACE ENTRY



# TRAINING OBJECTIVES

- **Cal/OSHA CSE Permit Requirements**
- **Understand all the hazards the may exist**
- **Hazard controls**
  - Air Monitoring and Ventilation Equipment
  - Retrieval devices
  - Personal protective equipment
- **Evaluate the CSE for safe entry, establish procedures**
- **CS entry when an attendant is not required**
- **Role of the entrant, attendant and supervisor**
- **When emergency rescue teams are needed**
- **Administrative controls that apply to CSE**



# CAL/OSHA REQUIREMENTS

- **Evaluate the space to determine if it is**
  - Full permit required confined space
  - C-5 permit space
  - Non-permit confined space
- **Inform exposed employees of hazards**
- **Develop written program to fit the needs**
- **Identify specific hazards, their controls and develop safe entry procedures**
- **Train CS entrants, attendants, supervisors on all aspects of the program**



# CAL/OSHA CSE DEFINITIONS

- Large enough and so configured that an employee can enter and perform work
- Space has limited or restricted means for entry or exit
- Is not designed for continuous employee occupancy
- Question: At what point is it considered that you have entered the confined space?



# TYPES OF CONFINED SPACES

- **Evaluate all confined spaces using Confined Space Flow Chart**
  - Full Permit Confined Space – Hazards exist. Avoid entry if possible, try to eliminate hazards. Great deal of precaution is necessary.
  - C-5 Permit Confined Space – Only hazard is atmospheric. Hazards are eliminated or controlled by forced air ventilation
  - Non-Permit Confined Space - Still a confined space but no or little hazard. Entry procedures help to control or eliminate other hazards that may exist.



# CONFINED SPACE HAZARDS

- **Oxygen Deficiency - acceptable entry when oxygen is between 19.5% and 23.5%**
- **Carbon Monoxide - Permissible Exposure Limit (PEL) is 35ppm for 8-hour TWA**
- **Flammable Gasses - Keep concentration below 10% of the Lower Explosive Limit (LEL)**
- **Hydrogen Sulfide – PEL is 10 ppm for 8-hour TWA. Colorless gas with a strong odor of rotten eggs**
- **Other toxics that may be brought into space**
- **Always test for oxygen first**



# CSE HAZARD - OXYGEN DEFICIENCY

- **Oxygen deficiency can be caused by:**
  - Combustion - fire, welding, operation of internal combustion engines
  - Formation of rust consumes oxygen
  - Decomposition of organic matter, consumes oxygen and produces methane gas which can displace oxygen
  - Displacement of oxygen by a heavy gas that has settled in a low-lying space



# EFFECTS OF OXYGEN DEFICIENCY

- **Below 6% - Difficulty breathing, convulsive movements, death in minutes**
- **6 - 10 % - Nausea, vomiting, loss of ability to move, unconsciousness, death**
- **10 - 14% - Faulty judgement, poor muscle coordination, rapid fatigue**
- **12 - 16% - Increased rate of breathing and heartbeat, impaired thinking/coordination**
- **16 - 19.5% - No visible effect**



# CSE HAZARD - CARBON MONOXIDE

- **Carbon monoxide results from incomplete combustion of processes.**
  - Sources are gasoline engines, acetylene welding, industrial heating (boilers)
- **CO is a colorless and odorless gas that displaces oxygen in the blood**
- **Purified air respirators are not effective protection**
- **PEL is 35ppm for 8 hour TWA**
- **Ceiling limit is 200ppm for STEL**



# EFFECTS OF CO LEVELS

- 100ppm for 3 hours or 600ppm for 1 hour - headache and discomfort
- 500ppm for 1 hour or 1000ppm for 30 min. - pounding of heart, dull headache, dizzy, flashes before eyes, ear ringing, nausea
- 1500ppm for 1 hour - Dangerous to life
- 4000ppm - Rapid collapse, unconsciousness and death within a few minutes



# FLAMMABLE GASES - ISOPROPYL ALCOHOL

- **Concentration of Isopropyl Alcohol (IPA) could lead to explosive atmosphere**
- **Colorless liquid with an odor of rubbing alcohol**
- **Odor threshold - identifiable at 200ppm**
- **Irritation level - mild irritation to eyes, nose and throat at 400ppm for 3 to 5 minutes**
- **IPA can be detected below the PEL**
- **Flammable limits in air - Lower = 2%, Upper = 12% (200ppm = .02%)**



# FLAMMABLE GASES - HYDROGEN SULFIDE

- H<sub>2</sub>S is extremely flammable – HMIS = 4
- Colorless gas with an odor of rotten eggs
- Odor threshold - identifiable at less than 15 ppm
- Irritation level - irritation to eyes, nose and throat at 15 – 50 ppm
- Exposure for more than 30 minutes at > 700 ppm have been fatal
- Flammable limits in air - Lower = 4%, Upper = 44% (400ppm = .04%)



# LEL EXAMPLE FOR H2S

- H2S has detectable odor threshold of 0.5ppm
- H2S has lower explosive limits (LEL) of 4% or 40,000ppm
- Air monitors are set to alarm at 10% of LEL (.4% or 4000ppm)



# HYDROGEN SULFIDE

- **Colorless gas with a strong odor of rotten eggs – extremely flammable**
- **Heavier than air and may accumulate in low areas**
- **Sense of smell becomes rapidly fatigued and cannot be relied upon to warn of the continuous presence of gas**
- **Monitor alarms at 10 ppm. OSHA has a 20 ppm ceiling limit TWA and 15 ppm short term exposure limit**
- **Irritating to the eyes, mucous membranes and respiratory system**



# OTHER CONFINED SPACE HAZARDS

- Slip and fall during entry, egress or while in confined space conducting work
- Striking fixed object, pipes, etc.
- Electric powered mechanical components, gears, pulleys, belts - LOTO
- Electrical shock hazards
- Chemicals brought into the workspace such as coatings, lubricants, solvents
- Chemicals that may enter space from other sources or adjacent processes
- Hot work conducted in space requires a permit, re-evaluate the confined space



# CONFINED SPACE DATA SHEET

- **Data Sheet must be completed prior to CS entry**
- **Forman authorizes entry**
- **List tasks to be conducted in space**
- **Review all safety and health hazards and controls. List any additional hazards/controls**
- **Review air monitoring procedure**
- **Are there any other permits needed to conduct the work in this space?**
- **Return completed Data Sheet to Carla**



# PRE-ENTRY CS HAZARD CONTROLS

- **Monitor air to check the following levels and document the readings.**
  - Oxygen
  - Carbon monoxide
  - Lower explosive limit
  - Other toxics
- **Continuous forced air ventilation to confined areas when necessary**
- **Energy lockout and tagout procedures**
- **Flow lines disconnected, blinded and locked out and chemical residue removed**



# PROTECTIVE EQUIPMENT AND GEAR

- Protective wear such as gloves, aprons, boots
- Protective eyewear, goggles or face shield
- Do not wear contact lenses when working in confined spaces
- Respirators or SCBA\* respirators
- Continuous forced air
- Continuous air monitoring
- Fall protection equipment and gear
  - Tripod and winch
  - Inspect prior to use



# FALL PROTECTION INSPECTION

- **Entrant must inspect fall protection gear prior to use**
  - Self retracting lifelines or hoist
  - Body harness
  - Lanyards (nylon webbing lifeline)
  - D-Rings (self locking swivel snap hook)
  - Impact indicator
  - Anchor and connection points
- **Competent person must inspect equipment at least every 6 months.**



# AIR MONITORING AND VENTILATION EQUIPMENT

## ■ Air Monitors

- Identify /evaluate any hazardous atmospheres that may exist or arise
- Record results on permit
- Test stratified atmospheres
- Test for oxygen first
- Combustion gases next
- Toxic gases tested last
- Calibrate equipment
- Document the results

## ■ Ventilation Blowers

- 100% outside air from clean source
- Open other vents
- Cannot enter until hazardous air is gone
- Forced air ventilation until atmospheric conditions are satisfactory
- Test air periodically to ensure ventilation is preventing bad air



# NON-PERMIT CONFINED SPACE REQUIREMENTS

- Permit space poses no actual or potential atmospheric hazards and if all hazards within the space are eliminated without entry into the space
- Testing and inspection demonstrate that hazards have been eliminated, space can be reclassified as long as the hazards remain eliminated
- Control of hazards through forced air ventilation does not constitute elimination of the hazards.
- Document the basis for hazard elimination
- If hazards arise, exit the space and re-evaluate to determine if space should be reclassified



# ROLE OF THE ATTENDANT

- **The attendant**
  - Does not enter the confined space
  - Is prepared for non-entry rescue
  - Knows the hazards or potential hazards of the space
  - Watches for behavioral changes in entrant
  - Monitors areas inside & outside the space
  - Remains outside the space until relieved by another attendant
  - Communicates with entrants
  - Orders evacuation if prohibited or hazardous conditions arise



# CONDITIONS FOR CS ENTRY WITHOUT AN ATTENDANT

- Hazards are known and controls are in place
- Fall exposure is minimal, easy extraction if necessary
- Continuous forced air ventilation maintains safe environment
- Continuous monitoring of air quality in the confined space
- Exit the space when the monitor signal alarm is activated (self rescue)



# WHEN RESCUE IS NECESSARY

- **Self rescue is best**
- **If entrant is disabled, conduct non-entry rescue using extraction equipment**
- **If rescue requires entry, rescue plan must be developed in advance of entry**
- **Outside rescue team must be available within 4 minutes**
  - **Must be able to verify atmospheric conditions within space are safe for rescue team to enter**
- **Extraction equipment and harness should be worn by entrant while in spaces with unusual configurations that could make extraction of injured person difficult**
- **MSDS for hazardous materials readily accessible**



# CSE ADMINISTRATIVE REQUIREMENTS

- Annual program review by safety administrator, make appropriate revisions
- Maintain records for minimum of 5 years
- Supervisors will ensure initial and periodic training of affected staff
  - Retraining necessary if shown it is necessary
- Re-classify confined spaces as necessary and if conditions change with the space



# CONFINED SPACE ENTRY SUMMARY

- **Know your confined spaces**
- **Attend mandatory training, cannot enter space unless trained and authorized**
- **Inspect the space for unusual conditions**
- **Monitor the air and ventilate if necessary**
- **Exit immediately if the monitor signals an alarm**
- **Secure the space when entry is completed**
- **Complete the confined space paperwork**



# Injury Prevention and Workers' Compensation Claims Management



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