# **Confined Space Hazards And Procedures AR** Training DMME **Division of Mineral Mining Updated 2012**

## What is a Confined Space?

#### A confined space ...

• Is large enough and so configured that an employee can bodily enter and perform assigned work.

• 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).

• Is not designed for continuous employee occupancy.

# **Typical Confined Spaces**

Boilers & Furnaces □ Silos & Storage Tanks □ Bins & Hoppers Pipelines **D** Pits □ Trenches & Excavations





Trenches and other excavations may be considered confined spaces, if there is a potential for accumulation of toxic gases, engulfment and/or the depletion of oxygen.



# **Controlling Confined Space Hazards**

•Each confined space has different hazards. Hazards can also change with time and usage.

- Post signs to warn of the dangers.
- Monitor entry conditions.
- Define acceptable entry conditions and PPE to be used.
- Specifically outline lock-out, tag-out procedures.
- Develop and use a written confined space entry program.
- Use barriers to prevent uncontrolled access.
- Conduct air monitoring to identify and evaluate hazards.
- Eliminate or control the space's hazards before entry.

## **Task Training**

All employees required to enter confined or enclosed spaces must be instructed in:

- Nature and recognition of the hazards
- Necessary precautions to be taken
- Use of protective and emergency equipment

### **Hazards of Confined Spaces**

Engulfment or Entrapment ✓ Atmospheric ✓ Electrical ✓ Physical Configuration Mechanical ✓ Thermal



#### **Engulfment Hazards**

# **Engulfment is the entrapment of a person by the contents of a space:**

- Crusting or bridging of material
- Small granular material
- Liquids
- Flooding

**Completely empty the contents before entry or work only from above the contents.** 

Use safety harness, lines and fall arrest equipment to prevent falling into the contents of a space.

## **Engulfment Facts**

• A person caught in granular material up to his/her knees probably will not be able to free himself without help. Struggling movements may cause them to sink deeper into the pile.

• A person trapped to the waist may require as much as 500 lbs. of force to remove them.

• A person trapped above the waist will quickly find it difficult to breathe as the material settles against them and restricts diaphragm and chest movement.

• A person may be asphyxiated even though their head is not covered!!

## **Atmospheric Hazards**

Oxygen Deficient Atmospheres
 Oxygen Enriched Atmospheres
 Flammable Atmospheres
 Toxic Atmospheres
 Asphyxiating Atmospheres



#### **Oxygen Deficient**

**19.5 % is the minimum acceptable oxygen** level for work without an air supplied respirator.

12-14% Respiration increases. Poor judgment.

- 10-12% Lips blue. Mental Confusion.
- 8-10% Fainting & Nausea.
- 6-8% Causes Death.

# Oxygen Deficiency Can Be Caused By Several Processes:

**Consumption:** oxygen is used up by the persons or activities in the confined space.

**Displacement:** denser materials push the oxygen out of the occupied space.

**<u>Reaction</u>**: oxygen is reacted with other materials to make other compounds.

## **How It Happens**

• Given a fixed amount of oxygen, as you would have in a confined space, human respiration of oxygen causes carbon dioxide to increase.

• The processes of combustion use up oxygen much faster than human respiration.

• Products of combustion vary with the fuel that is present and the temperature of the combustion reaction. Welding, using an acetylene torch and burning natural gas or propane will all use up the available oxygen and create harmful gases to replace it.

## **Oxygen Enriched**

Oxygen level above 21%.

 Causes flammable and combustible materials to burn violently when ignited. Such as: Hair, clothing, oil soaked materials/rags, etc.
 Never use pure oxygen to ventilate.

• Never store or place compressed gas tanks in a confined space.

• Be sure there are no leaks in torch valves and hoses.

#### **Flammable Atmospheres**

- Required Factors:
  - •Oxygen
  - •Flammable Gas, Vapor or Dust
  - •Ignition Source:
    - ✓ Welding
    - ✓Torches
    - ✓ Electric Tools
    - ✓Smoking



#### **Toxic Atmospheres**

• Materials in space prior to entry ✓ Combining/reacting materials can "gas off". ✓ Decomposition of materials. Work being performed ✓ Welding, cutting, brazing, soldering. ✓ Painting, scraping, sanding, degreasing. ✓ Sealing, bonding, melting. ✓ Cleaning, de-scaling.

## **Asphyxiating Atmospheres**

**Reduction of oxygen in a confined space may be the result of either consumption or displacement.** 

As discussed earlier, these take place during:

✓ Combustion of flammable substances, as in welding, heating, cutting, and brazing.

✓ The above actions which create other gases/compounds that take oxygen's place.

Chemical reactions as in the formation of rust.

\* <u>Yes</u>, in a closed space, the creation of rust will deplete oxygen!

# **Testing The Atmosphere**

Verifying the presence of a safe work atmosphere:

Calibrate Air Monitoring Equipment before use.
Test all areas of a confined space; top, middle and bottom.
Check for Explosive & Toxic Gases
Check Oxygen level

\*Record all readings!

#### Ventilation

- Consider which is best; exhaust or supply or both.
  Provide work-zone exhaust if welding.
  Plan ventilation supply and exhaust paths.
  Ensure no "re-circulation" of air supply.
  Use continuous ventilation.
- Retest the confined space once ventilation is active.

#### **Electrical Hazards**

Shock is a possible hazard in confined spaces

Sources include:

✓ Broken lighting.

Sensing devices, limit switches, level indicators, etc.

✓ Hazards from equipment taken inside;
 power tools and welding electrodes.

#### **Mechanical Hazards**

Some confined spaces have unguarded mechanical equipment such as:

- Paddles
- Blades
- Shafts

• Chain or belt drives

All equipment must be locked out and tagged before entry!!

# LOCKOUT!

Lock & tag ALL electrical sources. Lock & tag ALL mechanical devices posing a hazard (valves, handles, etc.). Blank & bleed fluid or air lines, if appropriate. Disconnect mechanical drives, if appropriate. Secure any mechanical parts posing a hazard.

• A written plan should be made for entry and rescue from bins, hoppers, silos and other confined spaces as appropriate. Specific instructions should be posted where workers can readily refer to them before starting such work.

• Have a "permit only" entry program, if applicable.

• All persons required to do such work should be properly task trained and advised of the hazards.

- Lock out, Tag out procedures STRICTLY ENFORCED!!!
- Make certain fall protection equipment is readily available such as harnesses and shock absorbing lanyards.
- **CONSIDER;** if a worker becomes trapped or injured, can one lifeline attendant safely rescue them? Most would have trouble pulling up a person's dead weight and probably could not free them even if only engulfed to the knees. *Be certain enough people are available in case of an emergency!*

• Hoppers can be designed to reduce the need for entry. The feed angle of the bottom of the hopper should be steep enough to induce free flow and reduce clogs. Low friction materials can be used as liners.

• The preferred installation will have a suspended and adjustable platform that can be lowered into place to allow work from above the trouble spot.

• Bins and hoppers should be kept empty whenever possible, especially during extended shutdowns and during periods of subfreezing temperatures to reduce the chance of materials adhering to sides and floors which can cause jams.



#### **Remember!**

•Any bin, hopper, silo, or pile of granular material may look deceptively harmless, however the center of the material may collapse suddenly. Free flowing material such as sand, coal, or limestone will, at any moment, increase its flow and move rapidly.

#### **Remember!**

•Bins and hoppers are often equipped with unloading equipment which may be started inadvertently drawing the worker into the material or equipment.

•Bins larger than 20 feet in diameter pose greater hazards than smaller ones because of larger masses of material.