SAFETY

Based on past studies, the water and wastewater industries have the highest injury rates in the nation. Workers in these areas are involved in construction and excavations, confined spaces, hazardous chemicals, and mechanical equipment that pose a serious injury risk when proper training, equipment, and procedures are not utilized. The Occupational Safety and Health Administration (OSHA) is responsible for developing regulations regarding worker safety and protection.

Employers are responsible for providing employees with the proper safety equipment and training in its use. They are also responsible for development and implementation of safety policies for their workplace. The employees, after proper training, are responsible for recognizing the safety issues: following approved safety procedures, and properly utilizing the associated safety equipment.

LOCK OUT/TAG OUT (LOTO)

Lock out/tag out regulations deal with the need to isolate a machine from its energy source to prevent it from starting while work is being done in and around the equipment. Energy sources can include electrical, hydraulic, pneumatic, thermal, and chemical. This can be either active or stored energy. Stored energy can take many forms. Some examples of stored energy are electrical energy stored in capacitors, pneumatic energy stored in a compressor tank, and hydraulic water pressure in an isolated line. Stored energy must be dissipated prior to working on the equipment. Employers are responsible for establishing an "Energy Control Plan" for LOTO work and supply each worker with their individual LOTO locking devices. Only trained personnel should conduct lock out/tag out procedures.

LOTO requires each worker to attach their personal LOTO lock to the disconnect or isolation device to isolate and de-energize these sources and lock and tag them prior to working on the equipment or process. This assures that the equipment cannot be restarted until each individual is finished with their task and is clear of the equipment.

Any isolation that can be locked must be locked. Lockout devices may also include chains, valve clamps, wedges, jacks, or key blocks. Tags are essentially warnings affixed to energy isolating devices and do not provide the physical restraint provided by a lock. Lockout devices and tag out devices must indicate the identity of the employee.

Anyone who enters a LOTO work area must be informed that a LOTO situation exists. If they are to be involved in the work, they must also apply their own LOTO locks. The employee who applied the device shall remove each lockout or tagout device from each energy-isolating device. If that employee is not available, the supervisor may remove the lock or tag only if reasonable attempts were made to contact the employee. Also, the supervisor must inform the employee as soon as that person returns to work. If equipment must be temporarily restarted, the LOTO must be removed during the restart and reapplied before work can continue.

CONFINED SPACE ENTRY

The water and wastewater industry has one of the highest numbers of confined space injuries per capita in the country. The vast majority of confined space related injuries result in fatalities. Another disturbing fact is that 60% of the confined space related fatalities are people who tried to rescue someone else from a confined space.

A confined space is defined by the following parameters:

1) It must be large enough for a person to enter and do work.
2) It has openings that make entry or exit difficult.
3) It is not intended for continuous occupancy.
4) Any open surface tank deeper than four feet.

Confined spaces fall into two categories: permit required and non-permit required. A confined space becomes permit required when it has potential for a hazardous atmosphere, potential for engulfment, a hazardous internal configuration, or other recognized hazards such as dangerous equipment or hot work (welding, cutting torch, etc.) that is in progress.

All employees involved in confined space entries must have the proper training in entry procedures and use of safety equipment. An entry supervisor is responsible for conducting the testing and completing the permit. Atmospheric testing should include oxygen concentration, Lower Explosive Limit (LEL) for explosives, and any toxic gases that may be present. The oxygen concentration must be between 19.5-23.5%. The alarm point for explosives is 10% of Lower Explosive Limit. The alarm point for hydrogen sulfide gas is 10 ppm. The alarm point for carbon monoxide is 35 ppm.

An attendant must be present and stationed outside the confined space to monitor the entrants while they are working. The attendant must maintain constant verbal and visual communications with the entrants. The attendant must also be prepared to instruct the entrants to exit the confined space should the equipment fail or the entrants exhibit impaired judgement.

Any confined space must be tested for a hazardous atmosphere before the entry. Monitoring must continue while the entrants are in the confined space. Permit required confined spaces also require ventilation during the entry and self-contained or supplied air must be used if ventilation fails to produce a safe atmosphere. Permit required confined space entries also require rescue equipment such as a harness and tripod for emergency rescues. If the space is configured in a way that prevents the use of self-rescue equipment, an emergency rescue team must be on-site during the entry. When the entry is completed, the entry supervisor must complete the permit form and file a copy with the appropriate supervisor and a confined space entry master file. Non-permit confined spaces must be reassessed periodically. Any non-permit space can be reclassified, as permit required, based on the results of these assessments.

HAZARD COMMUNICATION STANDARD

OSHA established the Hazard Communication Standard in 1986. The standard was created to provide an information system on hazardous chemicals for both employers and employees. The Haz-Com Standard requires employers to ensure their employees know what hazardous materials exist in the workplace, how to safely use these materials, and how to deal with any emergencies that arise during use. Employers are required to provide the proper safety equipment, train employees in the safe use of any hazardous materials on a jobsite, and maintain records of both.

Producers of hazardous materials are required to provide customers with a Material Safety Data Sheet (MSDS) for each individual chemical or material. MSDS's must be kept on file and available to employees. Employee training should also include how to read and understand the information on the MSDS. The hazards that are involved fall into two basic categories.

TYPES OF HAZARDS:
Health Hazards
Physical Hazards

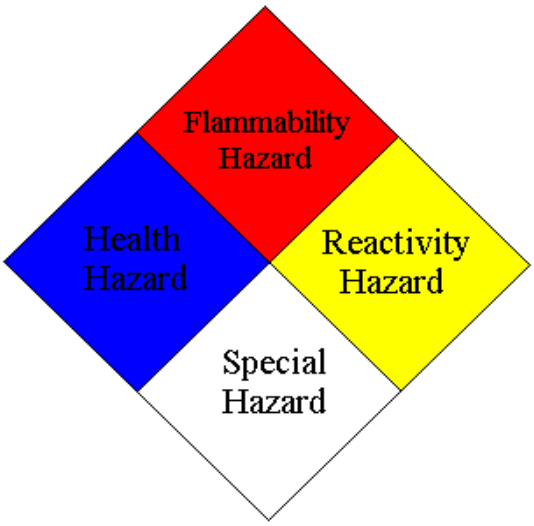
Health hazards refer to immediate or long-term harm to the body caused by exposure to hazardous chemicals. Physical hazards like flammability or corrosivity can also cause injury to skin, eyes and the respiratory system. MSDS's are divided into eight sections.

Material Safety Data Sheet Sections

1. **Manufacturer's Contact Information**
2. **Hazardous Ingredients/Identity Information**
3. **Physical/Chemical Characteristics**
4. **Fire and Explosion Hazard Data**
5. **Reactivity Data**
6. **Health Hazard/First Aid Information**
7. **Precautions for Safe Handling and Use**
8. **Control/Cleanup Measures**

NFPA COLOR-CODE WARNING SYSTEM

Hazardous materials stored in tanks or containers require hazard identification labels for plant workers and other personnel. One method of labeling is the NFPA diamond. The NFPA symbol has four color-coded diamond-shaped sections. The top (red) diamond is the Flammability Hazard rating. The left (Blue) diamond is the Health Hazard rating. The right (yellow) diamond is the Reactivity Hazard rating. The bottom (White) diamond contains special symbols to indicate properties not explained by the other categories. A number–based rating system is used for each section, ranging from 0 – least dangerous to 4 – extremely dangerous. Emergency responders, such as firefighters, can quickly assess the hazard when they arrive at a chemical spill at a facility.



NFPA Placard

SPECIAL HAZARD SYMBOLS

Acid	**Acids**
Base	**Alkalyes, cyanides**
Oxy	**Oxidizers**
Flam	**Flammables**
Rad	**Radioactive**
W	**Use no water**

FIRE EXTINGUISHER SAFETY

Different types of fires require different types of fire extinguishers. Fire extinguishers are all rated based on the type of fire they can put out. **Class A** fires are combustible materials like wood or paper. **Class B** fires are flammable liquids like gasoline, oil, or organic solvents. **Class C** fires are electrical fires. Many fire extinguishers are rated for multiple uses. **A-B-C** fire extinguishers can be used on any of these three types of fires

Fire extinguisher use has been simplified to an acronym, **P. A. S. S.**

- **P**ull the pin
- **A**im at the base of the fire
- **S**queeze the trigger
- **S**weep the area

EXCAVATION SAFETY

Proper shoring or sloping of trenches and excavations is a major safety issue for many distribution system operators. New construction usually involves more controlled conditions than emergency repairs. Excavations for emergency repairs almost always involve digging and shoring in saturated soils and flooded trenches. A "competent person" must supervise all excavation operations. A competent person is someone who has extensive training in soil mechanics and shoring operations.

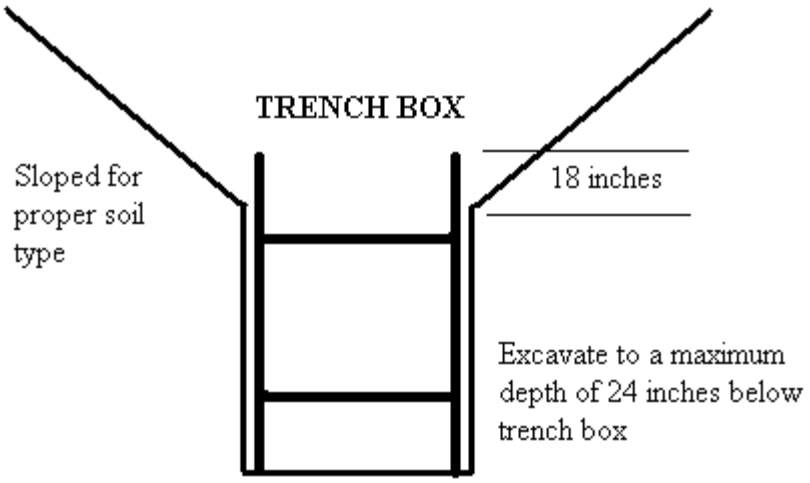
All trenches over 4 feet deep must have ladder from entry and exit. The ladders must extend at least 3 feet above the top of the trench and ladders must not be stationed more than 25 feet apart. Trenches over 5 feet deep must be properly shored or sloped to protect entrants from trench wall collapse and cave-ins. The competent person must determine the proper Maximum Allowable Slope, formerly referred to as Angle of Repose, for the given soils type. Soils are classified as Stable Rock or Type A, B, or C. Stable rock is natural solid mineral material that can be excavated with vertical sides and remain intact while exposed. Type C soils are the least stable and require the shallowest Maximum Allowable Slope. Repair excavations are almost always in wet soils. Soils that are saturated with water are considered to be Type C soils.

Soil Types and Maximum Allowable Slope

Stable Rock	**Vertical**	**90°**
Type A	**¾:1**	**53°**
Type B	**1:1**	**45°**
Type C	**1½:1**	**34°**

Shoring must be installed without worker entry into the excavation. Screw jacks or cross braces must be installed from the top down and removed from the bottom up. This prevents entrants from working in an unprotected area. Jacks and cross braces must be anchored by nailing the foot to the vertical timbers. Hydraulic or pneumatic shoring can be installed without requiring worker entry into the trench. If water is used for hydraulic shoring, antifreeze should be added to prevent freezing in cold weather.

Trench boxes are useful for long trenches where it can be moved along the trench. This saves some of the setup and breakdown time required with shoring. When the excavation is deeper than the trench box, the portion above the box must be sloped based on the soil type. The trench box must extend at least 18 inches above the beginning of the sloped wall. Excavation below the trench box is allowed, but the maximum depth is 24 inches. Ladders must be positioned so that workers can enter and exit without stepping outside the shoring or trench box.



Trench Box Placement

Excavations may become confined spaces if they are located close to a source of potentially hazardous gases (underground gas tanks, landfills, etc.) Spoil from the excavation must be placed at least 2 feet from the edge of the excavation (farther with more unstable soils.)

BASIC STUDY QUESTIONS

1. What does locking out a piece of equipment mean?

2. What must be done prior to entering a confined space?

3. What is the maximum allowable depth of an unshored excavation?

ADVANCED STUDY QUESTIONS

1. How many locks must be attached to an energy isolation device?

2. What are types of conditions are included in confined space atmosphere testing?

3. What are the maximum allowable slopes for Types A, B, and C soils?

4. How is stable rock defined for trenching and shoring?

BASIC SAMPLE TEST QUESTIONS

1. Ladders must extend at least ___ feet above the trench?

   A. 1
   B. 2
   C. 3
   D. 4

2. An attendant must be stationed outside every confined space entry.

   A. True
   B. False

3. Each worker must attach a LOTO lock on a locked out machine.

   A. True
   B. False

ADVANCED SAMPLE TEST QUESTIONS

1. Oxygen levels in a confined space must be between _____ before the space can be entered.

   A. 10.5-13%
   B. 16-18.5%
   C. 19.5-23.5%
   D. 42.6-51.4%

2. The maximum excavation depth below a trench box must not exceed:

   A. 12 inches
   B. 18 inches
   C. 24 inches
   D. 36 inches

3. Which of the following are potential sources of energy that must be isolated during LOTO procedures?

   A. Hydraulic energy
   B. Electrical energy
   C. Pneumatic energy
   D. All of the above

4. Ladders must be located no more than ___ feet from workers.

   A. 10
   B. 25
   C. 35
   D. 40

5. A standby attendant for a confined space entry must:

   A. Be in visual and verbal contact with the entrants
   B. Be able to communicate with emergency responders in case of an accident
   C. Terminate the entry if problems develop
   D. All of the above