SAFETY

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ACCIDENT

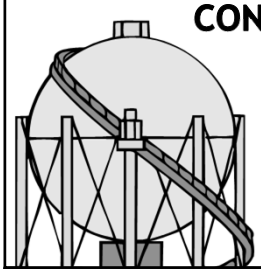
- An accident is caused by either an unsafe act or an unsafe environment

GENERAL DUTY CLAUSE

Federal – 29 CFR 1903.1

- EMPLOYERS MUST:
  - Furnish a place of employment free of recognized hazards that are causing or are likely to cause death or serious physical harm to employees
  - Comply with occupational safety and health standards promulgated under the Williams-Steiger Occupational Safety and Health Act of 1970.

CONFINED SPACES



CONFINED SPACE CONDITIONS

- Defined as any space where BOTH of the following conditions exist at the same time:
  - existing ventilation is insufficient to remove dangerous air contamination and/or oxygen deficiency which may exist or develop
  - ready access/egress for the removal of a suddenly disabled employee (operator) is difficult due to the location and/or size of opening(s)
- Large enough and so configured that an employee can bodily enter and perform assigned work
- Limited or restricted means of entry or exit
- Not designed for continuous employee occupancy

CONFINED SPACE EXAMPLES

- Vaults
- Silos
- Inside filters
- Basins
- Storage tanks
- Pits
- Hoppers

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EQUIPMENT NEEDED

- Safety harness with lifeline, tripod, and winch
- Electrochemical sensors
- Ventilation blower with hose

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EQUIPMENT NEEDED cont'd

- PPE
- Ladder
- Rope
- Breathing apparatus

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ATMOSPHERIC HAZARDS

- Need to have atmosphere monitored!!!
- In order
  - Depletion or elimination of breathable oxygen
  - Explosive or flammable air
  - Toxic air

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HYDROGEN SULFIDE – H_2S

- Detected by the smell of rotten eggs
- Loss of ability to detect short exposures
- Not noticeable at high concentrations
- Exposures to 0.07% to 0.1% will cause acute poisoning and paralyze the respiratory center of the body
- At the above levels, death and/or rapid loss of consciousness occur

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METHANE GAS – CH_4

- Product of waste decomposition
- Leaks in natural gas pipelines can saturate the soil
- Explosive at a concentration of 5%
- Spaces may contain concentrations above the Lower Explosive Limits (LEL) and still have oxygen above the 19.5% allowable
- Gasoline storage tanks, gas stations, petroleum product pipelines, accidental spills by traffic accidents

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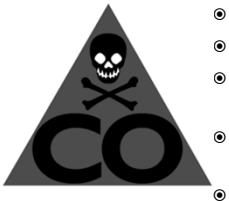
CARBON MONOXIDE - CO



- Decreases amount of oxygen present
- ALWAYS VENTILATE
- 0.15% (1500 ppm) = DEATH
- Will cause headaches at 0.02% in a two hour period
- Maximum amount of 0.04% in 60 minute period
- Colorless, odorless, tasteless, flammable and poisonous

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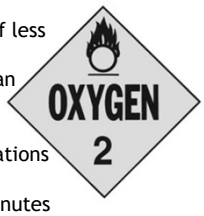
OXYGEN - O_2

- ALWAYS ventilate – normal air contains ~ 21%
- Oxygen deficient atmosphere if less than 19.5%
- Oxygen enriched at greater than 23.5%
  - Speeds combustion
- Leave area if oxygen concentrations approach 22%
- At 8%, you will be dead in 6 minutes
- At 6%, coma in 40 seconds and then you die



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OXYGEN - O_2

- When O_2 levels drop below 16%, a person experiences
  - Rapid fatigue
  - Inability to think clearly
  - Poor coordination
  - Difficulty breathing
  - Ringing in the ears
  - Also, a false sense of well-being may develop

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OXYGEN - O_2

- In a confined space, the amount of oxygen in the atmosphere may be reduced by several factors
  - Oxygen consumption
    - During combustion of flammable substances
    - Welding, heating, cutting or even rust formation
  - Oxygen displacement
    - Carbon dioxide can displace oxygen
  - Bacterial action

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ATMOSPHERIC ALARM UNITS

- Should continuously sample the atmosphere of the area
- Test atmospheres before entering
- Test for oxygen first
- Combustible gases second

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ATMOSPHERIC ALARM UNITS

- Alarms set to read flammable gasses exceeding 10% of the lower explosive limit
  - H_2S exceeds 10 ppm and/or O_2 percentage drops below 19.5%
- Calibrate unit before using
- Most desirable units simultaneously sample, analyze, and alarm all 3 atmospheric conditions

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SPACES THAT REQUIRE PERMITS

- Contains or has potential to contain hazardous atmosphere
- Contains material with potential to engulf and entrant
- Entrant could be trapped or asphyxiated

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WRITTEN ENTRY SYSTEM

- Employer shall document entry permits
- Entry supervisor signs permits
- Permit posted
- Shall not exceed time required
- Retain permits for at least 1 year

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INFORMATION ON PERMIT FORMS

- Space to be entered
- Purpose
- Date and authorized duration
- Attendant ID by name
- Authorized entrants ID by name
- Entry supervisor name and signature
- Hazards of permit space
- Measures to eliminate, isolate, or control the hazards
- Results of tests
- Rescue and emergency services
- Communications

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INFORMATION ON EQUIPMENT

- PPE (personal protective equipment)
- Testing equipment

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DUTIES OF ENTRANTS

- Know signs, symptoms, and consequence of exposure
- Properly use equipment
- Alert attendant of warning signs, symptoms and other possible hazards
- Exit when ordered to evacuate by supervisor or attendant

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DUTIES OF CONFINED SPACE ATTENDANT

- Know signs, symptoms, and consequences of exposure
- Possible behavioral effects of hazards
- Maintain accurate count of entrants
- Remain outside permit space
- Communicate with entrants
- Summon rescue and emergency units

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DUTIES OF CONFINED SPACE ATTENDANT

- Warn unauthorized persons to stay away
- Perform non-entry rescue
- Do not perform any duties that interfere with primary duty of monitoring and protecting entrants

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DUTIES OF SUPERVISORS AND MANAGERS

- Knowledge of signs, symptoms, and consequences of exposure
- Verify appropriate entries, procedures, tests and equipment
- Terminate entries and cancel permits if warranted
- Verify means for summoning rescue
- Ensure that acceptable conditions are maintained and operations remain consistent with entry permit

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REQUIRED TRAINING

- Employer shall train all employees on hazards, procedures, and skills to perform their jobs safely
- Employees trained before first assigned duty
- Employer shall certify training of employees
- Maintain individual training records of employees

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RECORD KEEPING

- Identification and evaluation of all hazardous areas in workplace
- Entrance permits filed
- Training certification
- Written confined space program

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GENERAL REQUIREMENTS

- Identify, evaluate, and monitor hazards in permit-required confined spaces
- Post signs “Permit Required”
- Prevent unauthorized entries
- Re-evaluate areas
- Inform contractors
- Have a written program available for employees
- Have proper PPE
- Annual training (OSHA requirement)

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CONFINED SPACE REQUIREMENTS

- All electrodes removed and machines disconnected from power sources
- Gas supply shut off
- Gas cylinders outside of work area
- All employees entering must undergo confined space training
- Ventilation used to keep toxic fumes, gasses, and dusts below max levels

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LOCKOUT / TAGOUT

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LOCKOUT/TAGOUT

General Requirements

- Written program
- Utilize tagout system if energy isolating device not capable of being locked out
- Lockout/tagout hardware provided
- Devices used only for intended purposes
- Tagout shall warn:
  - **DO NOT START. DO NOT ENERGIZE. DO NOT OPERATE.**
- Only trained employees shall perform lockout/tagout

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LOCKOUT/TAGOUT

Requirements When Lockout of Equipment

- Notify employees
- Employees notified after completion of work and equipment are re-energized

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LOCKOUT/TAGOUT

Recommended Steps for Lockout/Tagout

- Notify employees that device is locked and tagged out
- Turn off machinery normally
- De-activate energy
- Use appropriate lockout/tagout equipment
- Release any stored energy
- Try to start machine by normal means

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LOCKOUT/TAGOUT

Steps for Restoring Equipment

- Check area for equipment or tools
- Notify all employees in the area
- Verify controls are in neutral
- Remove lockout/tagout devices and re-energize device
- Notify employees maintenance and/or repairs are complete and equipment is operational

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LOCKOUT/TAGOUT

Training Requirements

- Employer shall train all employees
- All new employees trained
- Recognition of applicable hazardous energy
- Purpose of program
- Procedures
- Consequences
- ANNUAL REQUIREMENT

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LOCKOUT/TAGOUT

Inspections

- Conduct periodic inspection, at least annually
- Shall include review between the inspector and each authorized employee
- Recommendation
  - Frequent walk-throughs of work areas and observation of Maintenance and Operation area

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LOCKOUT/TAGOUT

Required Record Keeping

- Written lockout/tagout program
- Training
  - Annually and new employees
- Inspections
  - Annual including new equipment, inspection of devices, and procedures

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TOP 10 MOST FREQUENTLY CITED STANDARDS

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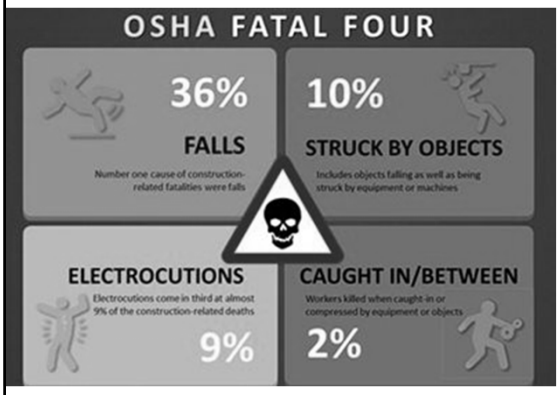

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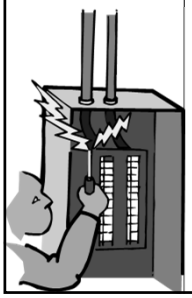

ELECTRICAL SAFETY

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ELECTRICAL SAFETY

OSHA says:

- Any electrical installations shall be done by a professionally trained electrician
- Any employee who is in a work area where there is a danger of electric shock shall be trained
- Employees working on electrical machinery shall be trained in lockout/tagout procedures

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TRANSFORMER

- Allows energy to be transferred in an AC system for one circuit to another
- Used to convert high voltage to low voltage
  - High voltage is 440 volts or higher
- Standby engines should be run weekly to ensure that it is working properly
- Relays are used to protect electric motors

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FIRE PROTECTION

FIRE PROTECTION

Equipment

- Fire extinguishers shall be located where they are readily accessible
- Shall be fully charged and operable at all times
- All fire fighting equipment is to be inspected at least annually

FIRE PROTECTION

Fire Protection Equipment

- Portable fire extinguishers inspected at least monthly and records kept
- Hydrostatic testing on each extinguisher every five years
- Fire detection systems tested monthly if battery operated

TYPES OF FIRE EXTINGUISHERS

- **Class A**
  - Used on combustible materials such as wood, paper or trash
  - Can be water based

- **Class B**
  - Used in areas where there is a presence of a flammable or combustible liquid
  - Shall not be water based
  - Example is dry chemical extinguisher
  - An existing system can be used but not refilled

TYPES OF FIRE EXTINGUISHERS

- **Class C**
  - Use for areas electrical
  - Best is carbon dioxide extinguisher
  - Using water to extinguish a class C fire risks electrical shock

- **Class D**
  - Used in areas with combustible metal hazards
  - Dry powder type
  - Use no other type for this fire

FIRE EXTINGUISHERS

Types of Fire Extinguishers

Class	Material	Method
A	Wood, paper	Water
B	Flammable liquids (oil, grease, paint)	Carbon dioxide, foam, dry chemical, Halon
C	Live electricity	Carbon dioxide, dry chemical, Halon
D	Metals	Carbon dioxide

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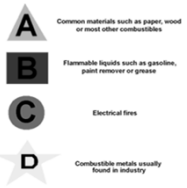
TYPES OF FIRE EXTINGUISHERS

- Combination ABC are most common
- Have the types of extinguishers available depending upon analyses performed in each area



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FIRE EXTINGUISHERS

- To operate a fire extinguisher, remember the word **PASS**
  - **P**ull the pin. Hold the extinguisher with the nozzle pointing away from you.
  - **A**im low. Point the extinguisher at the base of the fire.
  - **S**queeze the lever slowly and evenly.
  - **S**weep the nozzle from side-to-side.

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CHEMICAL SAFETY

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PERSONAL PROTECTIVE EQUIPMENT (PPE)

- Gloves
- Coveralls/overalls
- Face shield/goggles
- Respirator/SCBA
- Boots
- Ear plugs/muffs

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RTK LABELS

- "Right to Know"
  - In 1983, OSHA instituted Hazard Communication Standard 1910-1200, a rule that gives employees the right to know the hazards of chemicals to which they may be exposed in the workplace.

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NFPA

- National Fire Protection Association
- Chemical hazard label
  - Color coded
  - Numerical system
    - Health
    - Flammability
    - Reactivity
  - Special precautions
- Labels are required on all chemicals in the lab

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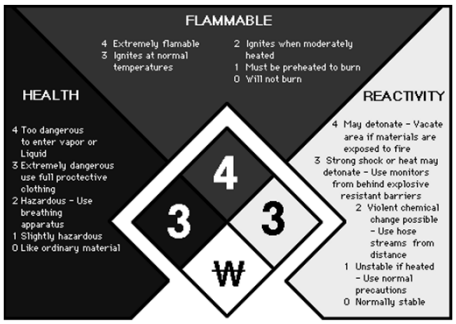
CHEMICAL HAZARD LABEL



CHEMICAL HAZARD LABEL

Degrees of Hazard

- Each of the colored areas has a number in it regarding the degree of hazard
  - 4 → extreme
  - 3 → serious
  - 2 → moderate
  - 1 → slight
  - 0 → minimal

CHEMICAL HAZARD LABEL

Special

- W → water reactive
- Ox → oxidizing agent

SAFETY DATA SHEET

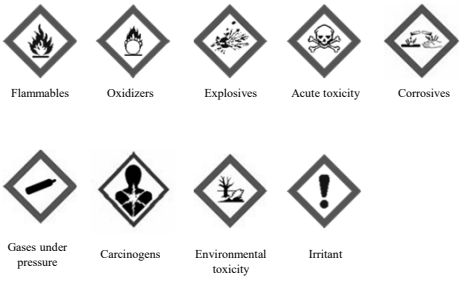
- OSHA moving from HCS (Hazard Communication Standard) to GHS (Globally Harmonized System)
- Revised criteria for chemical hazard classification, labeling & new format for Safety Data Sheets (SDS)
- Final rule effective May 25, 2012 but compliance dates are phased in:
  - Complete training on new label formats: 12/1/13
  - Comply with label and SDS requirements: 6/1/15
  - Update Hazcom programs: 6/1/16

MINIMUM INFO FOR SDS

- Product identification
- Hazard Identification
- Composition/info on ingredients
- First-aid measures
- Fire-fighting measures
- Accidental release measures
- Handling and storage
- Exposure controls
- Physical/chemical properties
- Stability & reactivity
- Toxicological information
- Ecological information*
- Disposal considerations*
- Transport information*
- Regulatory information*
- Other information (including date of SDS or last revision)

* Non mandatory

OSHA PICTOGRAMS



TN Department of Environment and Conservation

WORKPLACE LABELING

- Can HMIS or NFPA system be used?
- While, the hazard category does not appear on the label, consider

GHS Category	Hazard	HMIS/NFPA Category	Hazard
1	highest	1	slight
2	high	2	moderate
3	medium →	3	serious
4	low	4	severe

NFPA categories were intended for emergency response, not workplace hazards; only considers acute effects, does not consider chronic effects

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TERMS

- Lower Explosive Level (LEL)
  - minimum concentration of flammable gas or vapor in air that supports combustion
- Upper Explosive Level (UEL)
  - maximum concentration of flammable gas or vapor in air that will support combustion
- Teratogen
  - causes structural abnormality following fetal exposure during pregnancy
- Mutagen
  - capable of altering a cell's genetic makeup

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CHLORINE & HYPOCHLORITE SAFETY

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CHLORINE GAS – Cl_2

- 2.5 times as dense as air
- Liquid expands easily into gas at room temperature 460 times
- Pungent, noxious odor
- Greenish-yellow color
- Toxic by inhalation, ingestion and through skin contact
- May irritate or burn skin

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CHLORINE GAS – Cl_2

- Inhalation can cause serious lung damage and may be fatal
  - 1000 ppm (0.1%) is likely to be fatal after a few deep breaths
    - half that concentration, fatal after a few minutes
- It takes as little as 0.3 ppm to be detected as a distinct odor

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CHLORINE SAFETY

Safety Precautions for Chlorine Gas

- Compressed air
  - 30 minute capacity
- Annually inspected
- Trained/fit tested
- PPE
  - Rubber gloves
  - Apron
  - Goggles
  - Safety shower, eyewash

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CHLORINE SAFETY

Where Chlorine Gas Is Used:

- Separate room for chlorine, with window to view inside
- Ventilation provided for one complete air change per minute
- Air outlet located near the floor
- Air inlet near the ceiling
- Temperature controlled room, 60ºF
- Switches for lights and fans located outside of room, crash-bar on door inside of chlorine room
- Vents from feeders and storage shall discharge to the outside atmosphere, above grade

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CHLORINE SAFETY

Where Chlorine Gas Is Used (cont'd):

- Must have a chlorine gas detection device connected to an alarm that can be heard throughout the treatment plant
- All gaseous feed chlorine installations shall be equipped with appropriate leak repair kits
- A fusible plug, designed to melt at 158º to 165ºF (70-74ºC), is located in the valve on a 150-lb cylinder and on the head of a ton container
  - It is designed to relieve pressure in the cylinder or container when exposed to high heat
- Leak detection – an ammonia solution produces white "smoke" in the presence of chlorine
  - A sensor type leak detector is the best means of detecting small leaks, less than 1ppm

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CHLORINE GAS CONTAINERS

- 3 types of Containers
  - 150 lb cylinder – Emergency repair kit A
  - Ton cylinder – Emergency repair kit B
  - Railroad cars – Emergency repair kit C

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CHLORINE SAFETY

Calcium Hypochlorite (HTH)

- Dry, white or yellow granular material
- Strong oxidizer
- Reacts with organics and can start fires
- Gives off lots of heat when mixed with water
- Will give off chlorine gas when it reacts
- Always add HTH to water when mixing
  - **NEVER add water to HTH!!**

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CHLORINE SAFETY

Calcium Hypochlorite (HTH)

- Granular HTH is safer to work with than tablet or liquid form
- HTH should be stored in a cool dry place away from acids, reducing agents, paints, oils, and grease
- Use a carbon dioxide extinguisher to put out fires started by HTH

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CHLORINE SAFETY

Calcium Hypochlorite (HTH)

- If a small amount of calcium hypochlorite is spilled, the chemical should be disposed of by dissolving it in a large amount of water

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CHLORINE SAFETY

Calcium Hypochlorite (HTH) – PPE

- Eye protection, protective clothing
- Rubber gloves
  - It will react with leather
- Rubber boots
  - It will react with leather
- SCBA

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Safety Quiz

Lockout / Tagout

True or False

1. The term “lockout” means to block the flow of energy to equipment and keep it blocked by placing a lock to prevent accidental start-up.

   True False

2. The term “tagout” means to place a tag on the power source to identify yourself and the purpose of the lockout, and to warn others not to turn the power back on.

   True False

3. If someone else has already applied a lock and tag to a piece of machinery you need to work on, you should not add another one.

   True False

4. After locking and tagging out the equipment, you should test the equipment to make sure it won’t start.

   True False

5. You don’t need to use the lockout / tagout procedure if a machine has a built-in safety shut-off.

   True False

Confined Spaces

Fill in the blank:

6. A _____ is a form designed to make sure workers can safely enter a confined space by establishing procedures that must be followed.

7. The acceptable range for oxygen level in a confined space is _____ %.

8. List some activities that can reduce the level of oxygen in a confined space:

   _____

9. Entry-level permits should be kept on file for at least _____ year(s).

Multiple Choice

10. Which of these are examples of confined spaces? (Circle all that apply)
    a) Storage tanks
    b) Automobiles
    c) Meter pits
    d) Manholes
    e) Meeting rooms

11. When must the atmosphere of a confined space be tested?
    a) Only before a worker enters
    b) Never, if adequate ventilation exists
    c) Continuously
    d) Only if welding or painting is being performed

12. Some gases in a confined space can be:
    a) Colorless
    b) Odorless
    c) Deadly
    d) All of the above

True or False

13. If dangerous conditions exist, you do not have to wait for trained rescue personnel to perform a rescue.

True False

14. Carbon monoxide and hydrogen sulfide are two common dangerous gases found in confined spaces.

True False

Calcium Hypochlorite

Multiple Choice

15. Calcium hypochlorite:
    a) Is an oxidizer
    b) May cause a fire if contaminated
    c) Can release hazardous chlorine gas if stored improperly
    d) All of the above

16. Which form of calcium hypochlorite is the safest?
    a) Granular
    b) Tablet
    c) Liquid

17. Calcium hypochlorite should be stored away from:
    a) Acids
    b) Paint
    c) Reducing agents
    d) Oils and greases
    e) All of the above

18. What should be used to extinguish a fire involving calcium hypochlorite?
    a) Water
    b) Carbon dioxide
    c) Chemical smothering agents
    d) All of the above

19. When cleaning up a small spill, you should dispose of the calcium hypochlorite by:
    a) Burying it
    b) Placing it in the trash can
    c) Putting it back in the container
    d) Neutralizing it with acid or ammonia
    e) Dissolving it in a large amount of water

Fill in the blank

20. What personal protective equipment should you wear when handling calcium hypochlorite?

    _____

21. Why should smoking be prohibited in calcium hypochlorite storage areas?

    _____

22. Why must you never dispose of calcium hypochlorite in the trashcan?

    _____

Answers:

1. True
2. True
3. False
4. True
5. False
6. Confined space permit
7. 19.5% - 23.5%
8. Poor ventilation, welding, absorption, chemical consumption
9. One
10. A and D
11. C
12. D
13. False
14. True
15. D
16. A
17. E
18. B
19. E
20. Wear self-contained breathing apparatus and protective clothing to prevent contact with skin and eyes (rubber gloves and rubber boots)
21. Fire hazard
22. Can react with organic material and cause a flash fire

TOSHA Standards Requiring Annual Training

Class	Regulation	Who should attend?
Medical & Exposure Records	1910.20(g)(1)	All employees (inform-existence, person responsible, location, right of access
Emergency Action	1910.38(a)(5) 1910.38(b)(4)	All employees – based upon other standards and requirements
Noise	1910.95(k)	All employees exposed to an 8 hour TWA or greater of 85dBA
Emergency Response	1910.120(q)	Employees who respond to spills of hazardous chemicals
Personal Protective Equipment	1910.132(f)	Employees who wear PPE
Permit-Required Confined Space	1910.146(g)	Employees who enter, attend or supervise P.R. confined spaces
Lock-Out/Tag-Out	1910.147(c)(7)	Employees who work on machinery
First Aid	1910.151(b)	At least one employee on each shift, annual as required by other standards
Fire Brigade	1910.156(c)	All fire brigade members (quarterly and annually)
Portable Fire Extinguishers	1910.157(g)	All employees expected to use fire extinguishers
Fork Lift Trucks	1910.178(1)	Fork lift truck operators
Mechanical Power Presses	1910.217(f)(2)	Operators
Asbestos	1910.1001(j)(1)	All employees exposures at or above PEL or excursion limit
Lead	1910.1025(1)	Anyone with a potential for exposure at any level – copy of appendix A&B. If exposed at or above action level, must be trained
Bloodborne Pathogens	1910.1030(g)(2)	Employees who render first aid
Hazard Communication	1910.1200(h) TDL 800-1-9-.07	Employees exposed or potentially exposed to any type of chemicals
Hazardous Chemicals in Laboratories	1910.1450(f)(2)	Employees exposed to chemicals