"Safety Comes First"

Case Western Reserve University

Environmental Health and Safety

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Deck the Halls — But Do It Safely

Emergency rooms treat thousands of injuries involving holiday decorating every year. Here is some advice from the U.S. Consumer Product Safety Commission for keeping you and your family safe this season:

- Keep potentially poisonous plants (mistletoe, holly berries, Jerusalem cherry, and amaryllis) away from children.
- Make sure artificial trees are "fire resistant."
- For real trees, cut off about two inches of the trunk for better water absorption, remember to water it, and remove it when it's dry.
- Place your tree at least three feet from fireplaces, radiators, and other heat sources.
- Don't hang breakable ornaments or ornaments with small, detachable parts on lower tree branches where children can reach them.
- Avoid decorations that resemble candy or food—children might try to eat them.
- Choose tinsel or artificial icicles or plastic or non-leaded metals.
- Never place trimming near open flames or electrical connections.
- Remove all wrapping papers from tree and fireplace areas immediately after presents are opened.
- Don't burn papers in the fireplace. A flash fire could result, with wrappings igniting suddenly and burning intensely.
- Only use indoor lights indoors and outdoor lights outdoors.
- Use the right ladder for the task when hanging lights.
- Replace light sets with broken or cracked sockets, frayed or bare wires, or loose connections.
- Follow directions on the number of light sets that can be plugged into one socket.
- Turn off all lights and decorations when you go to bed or leave the house.

Source: Safety.BLR

OSHA's "Fatal Four" – Leading Causes of Fatalities in the Workplace

"An estimated 10.1% of deaths occurred due to swinging, falling, or misplaced objects."

Beginning in 1971, the Occupational Safety and Health Administration (OSHA) has partnered with employers, health and safety professionals, and other safety advocates as a means of establishing safe and healthful workplaces throughout the industry.
Fortunately, over the years, injuries and fatalities in the workplace have decreased substantially. Unfortunately, there are many workplace injuries and fatalities that continue to occur every day. OSHA reports that there is an average of 12 work-related fatalities throughout the United States every day.

As an example, the leading causes of workplace deaths in the construction industry, which is commonly called the "Fatal Four" by OSHA, include:

- **Falls:** Approximately 36.5% of all deaths in the workplace occurred due to employees falling. These includes workers who have fallen due to unprotected sides or holes, improperly constructed walking or working surfaces, workers who have fallen off ladders, roofs, scaffolding, large skyscraper construction areas, etc., all due to failure to use proper fall protection. Incorporating the OSHA fall protection requirements would resolve these issues, which includes 1910.269(g)(2) Fall Protection.
- **Struck by an Object:** An estimated 10.1% of deaths occurred due to swinging, falling, or misplaced objects. These also include falling objects due to rigging failure, loose or shifting materials, equipment malfunctions, and vehicle or equipment strikes.
- **Electrocutions:** About 8.6% of employees died due to electrocution. Workers face a number of electrocution risks on construction sites, such as exposed wiring, wet conditions while outlets are exposed, etc. These are caused by contact with overhead power lines or energized conductors or circuit parts in electrical panels and equipment panels, poorly maintained extension cords and power tools, as well as lightning strikes. Strict adherence to OSHA 1910.331-.335, 1910.269, and NFPA 70E *Standard for Electrical Safety in the Workplace* would prevent these accidents.
- **Caught-in or Caught-between:** Employees caught in or between machines, devices, or tools causing death accounted for about 2.5% of deaths. These also include trench or excavation collapses, as well as workers caught between moving or rotating equipment, or caught in collapsing structures or materials.

The 2017 OSHA Top 10 Citations provide another insight into the causes of worker injuries and fatalities.

1. Fall Protection – General Requirements (1926.501): 6,072 violations
2. Hazard Communication (1910.1200): 4,176 violations
3. Scaffolding (1926.451): 3,288 violations
4. Respiratory Protection (1910.134): 3,097 violations
5. **Lockout/Tagout (1910.147): 2,877 violations** – frequent violations were inadequate worker training and inspections not completed. Lockout/tagout

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OSHA's "Fatal Four", cont.

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procedures are meant to safeguard employees when machinery starts up unexpectedly or when hazardous energy is released during maintenance activities. Failing to train workers or conduct periodic inspections account for many of the violations.

6. Ladders (1926.1053): 2,241 violations
7. Powered Industrial Trucks (1910.178): 2,162 violations
8. Machine Guarding (1910.212): 1,933 violations
9. Fall Protection – Training Requirements: 1,523 violations
10. **Electrical – Wiring Methods (1910.305): 1,405 violations** – Violations of this standard were found in most general industry sectors, including food and beverage, retail, and manufacturing. Faulty electrical wiring methods accounted for 1,405 violations—down from 1,937 in 2016. Frequent violations include improper use of extension cords.

Electrical Hazards

The numbers of citations and fatalities by electrocution clearly show that exposure to electricity is a major hazard to workers. Electrocution results when a person is exposed to a lethal amount of electrical energy. An electrical hazard can be defined as a serious workplace hazard that exposes workers to the following:

- Burns
- Electrocution
- Shock
- Arc flash/arc blast
- Fire
- Explosions

Electrical workers had the most electrocutions per year with the most serious concern from working on "energized" energized electrical conductors or circuit parts or near enough to them to be exposed to the electrical hazards. Proper protocol is deenergizing and using lockout/tagout procedures, or more effectively establishing an electrically safe work condition per Article 120 of NFPA 70E-2018. Among non-electricians (e.g., mechanics, laborers, carpenters, supervisors of non-electrical workers and roofers), failure to recognize and avoid energized electrical conductors or circuit parts, as well as overhead power lines, and a lack of basic electrical safety knowledge are the major concerns.

Major types of electrocution incidents come from:

- Failure to recognize and come into contact with energized sources (energized conductors and circuit parts, damaged or bare wires, defective electrical equipment or power tools)
- Improper use of extension and flexible cords

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"Proper protocol is deener-gizing and using lockout/tagout proce-dures…"

OSHA's "Fatal Four", cont.

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- Contact with overhead power lines (some think these are "telephone wires")

To better protect against the electrocution hazards:

- Always lockout/tagout to control the electrical energy source(s)
- Never leave exposed energized conductors or circuit parts unattended (e.g., equipment doors left open or covers left off)
- Locate and identify utilities before starting work; overhead and underground
- Look for overhead power lines when operating any equipment that could make contact
- Maintain a safe distance away from power lines; learn the safe distance requirements
- Do not operate portable electric tools unless they are grounded or double-insulated
- Use ground-fault circuit-interrupters (GFCI) for protection; required for all maintenance and construction work
- Be alert for electrical hazards when working with ladders, scaffolds or other platforms

Taking all of this into consideration, we need to be aware that OSHA 1910.333 (c)(2), titled "Work of energized equipment, requires that "only qualified persons may work on electric circuit parts or equipment that have not been deenergized under the procedures of paragraph (b) of this section. Such persons shall be capable of working safely on energized circuits and shall be familiar with the proper use of special precautionary techniques, personal protective equipment, insulating and shielding materials, and insulated tools." OSHA 1910.335(a)(1)(i) further requires that "employees working in areas where there are potential electrical hazards shall be provided with, and shall use, electrical protective equipment that is appropriate for the specific parts of the body to be protected and for the work to be performed."

Training qualified electrical workers is vital to the success of any safety program. However, there are a large number of unqualified or non-electrical personnel who are, or may be, exposed to electrical hazards. Anyone who uses portable cord- and plug-connected electrical equipment or extensions cords are required to be trained on the proper selection, use, and inspection before use of this type of equipment.

Source: Safety BLR

"Locate and identify utilities before starting work; overhead and under-ground."

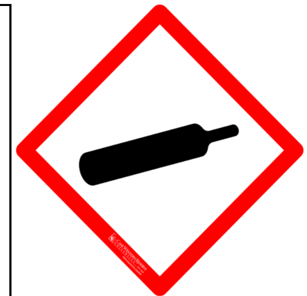
Handling Compressed Gas Cylinders

Compressed gases can be corrosive, flammable, explosive, toxic, or all these combined. Cylinders containing compressed gas need to be legibly marked for identification purposes. Typically, just below the cap on the bottle is the identification code and label stating the bottle's contents. The label must have a cylinder pictogram and pictograms of other hazards of the compressed gas.

Keep the following in mind when handling compressed gas cylinders:

- Always secure cylinders when in use, in storage, empty, and in transport. When a cylinder is not in use, it should have its protective cap on.
- Keep the cylinder away from all forms of fire- and spark-producing operations and electric lines. A compressed gas cylinder should never be exposed to such excessive heat that its outside surface exceeds 125 degrees Fahrenheit.
- Do not drop or bang cylinders together violently. Move them only with approved hand trucks. When transporting cylinders by crane, use approved material skiffs.
- Never mix cylinders (i.e., do not store propane cylinders and oxygen cylinders together).
- Compressed gas cylinders must be stored a minimum of 20 feet from combustible material such as grease, oil and paint.
- Mark cylinders when they are empty, and avoid storing them with full ones.
- Open the cylinder valve slowly, and do not use tools to force it open. If it is difficult to open, return the cylinder for a new one.
- Never take a compressed gas cylinder into a confined space. Always set the cylinder outside of the space and run the hose or tubing into the space.

Source: Safety BLR



"The label must have a cylinder picto-gram and picto-grams of other hazards of the com-pressed gas."

Vacuum Pump Explosion at University of Pennsylvania

“Follow all applicable state and local orders and directives...”

On the evening of August 14, 2020, a University of Pennsylvania chemistry graduate student was attempting to evaporate ethyl acetate and hexane using a Buchi Rotavapor (R-200) connected to a Savant VP100 rotary-vane roughing pump. The vacuum pump was located in a designated pump cabinet in the base of the fume hood. Power to the cabinet was controlled by a toggle switch on the face of the fume hood.

The student was alone in the lab at 6:30 PM when he engaged the power switch on the hood to turn on the vacuum pump. He reports that the vacuum monitor on the rotary evaporator indicated that the pump was not supplying vacuum, so he turned off the power switch. When he flipped the switch back on, he heard “a loud bang” and saw the cabinet door “burst open.” The vacuum pump was on fire, producing orange flames and black smoke.

The student was not standing in front of the cabinet when the explosion occurred and, as a result, was uninjured. The fire alarm was activated, and the fire department extinguished the fire using water.

Based on the information provided by the witnesses and responders, the most likely direct cause of the explosion was the ignition of an explosive concentration of diethyl ether vapor expelled from the pump exhaust. The source of ignition may have been either a spark from the pump motor or from the cooling fan inside the cabinet, both controlled by the same power switch. Diethyl ether, which was evaporated using this system earlier in the day, may have been pulled into the vacuum pump and then been exhausted into the cabinet. The vapor from the pump exhaust could have ignited when the student flipped the toggle switch to energize the pump and cooling fan.

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Vacuum Pump Explosion, cont.

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Lessons Learned

- All vacuum exhaust must be properly vented and include sufficient condensing capacity prior to the pump. The exhaust ports of pumps stored in vacuum pump cabinets must be connected directly to the vent port inside the cabinet. The pump may not vent into the cabinet interior. See photo for example of proper setup.

Note: This photo does not show an oil mist-separator on the vacuum exhaust. Oil mist separators are required for high vacuum pumps. Contact EHS at 216-368-2907 if you have any questions about your vacuum pump set-up.

- Any rotary evaporator systems that are using rotary vane pumps should be reviewed to determine whether the vacuum pressure is appropriate to the application and is well controlled. A less powerful vacuum pump with more precise vacuum control (such as a diaphragm pump) is more appropriate for rotary evaporation of low boiling solvents. Diaphragm pumps offer advantages including their small size, chemical-resistance, and ability to fit next to the rotavapor in the fume hood. For guidance on selecting the best vacuum pump for your application, see Labconco's "How to Select the Right Vacuum Pump" and "Lab Manager Magazine's Independent Guide to Purchasing a Vacuum Pump."

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"The pump may not vent into the cabinet interior."

Vacuum Pump Explosion, cont.

"It is important to select the right pressure and temperature when condensing solvent vapor in rotary evaporation."

- It is important to select the right pressure and temperature when condensing solvent vapor in rotary evaporation. For a sufficient condensation of the vapor, you should set the cooling temperature at about 20°C lower than the vapor temperature. This is known as the "Delta 20 Rule": set the bath temperature at 50°C to yield a solvent vapor temperature of 30°C, which is subsequently condensed at 10°C. See Buchi's Your Evaporation Guide - White Paper - Temperature difference for more information. Also, refer to the following Buchi recommendations for rotavap use and optimal settings:
  - Buchi Optimize Evaporation Poster
  - Buchi List of Solvents Vacuum Recommendation

- See Fact Sheet: Vacuum Pump Use and Installation for guidance on vacuum pump maintenance requirements. Keep detailed records of all pump maintenance including routine maintenance and vendor-provided services.

- Use a second cold trap between the pump and the experiment to minimize the amount of volatile chemicals reaching the pump. This will also help to protect the pump from damage caused by degradation and contamination of the pump oil. See Fact Sheet: Vacuum Pump Use and Installation for more information about pump setup and use of cold traps.

- Empty the condenser trap immediately after evaporation is complete to eliminate the possibility that solvent will evaporate as the condenser warms to room temperature.

PennEHRS
Environmental Health & Radiation Safety

Chemical Spotlight: Carbon Tetrachloride

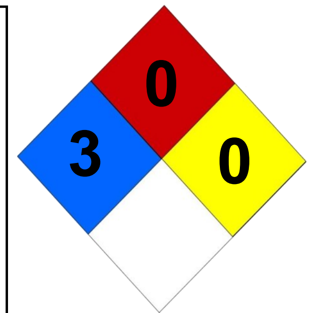
Carbon tetrachloride is a manufactured chemical that is a clear liquid with a sweet smell. This chemical is also known as carbon chloride, methane tetrachloride, perchloromethane, tetrachloroethane, or benziform. Carbon tetrachloride was previously used to produce refrigeration fluid and propellants for aerosol cans, as a pesticide, as a cleaning fluid and degreasing agent, in fire extinguishers, and in spot removers. These uses are now banned, and the chemical is only used for some industrial applications.

Carbon tetrachloride is most often found in the air as a colorless gas and evaporates quickly from surface water.

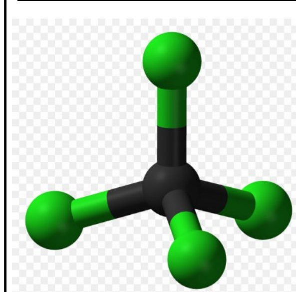
Don't use carbon tetrachloride near welding areas, flames, or hot metal surfaces. Phosgene and hydrogen chloride, which are poisonous gases, will be produced. Store carbon tetrachloride away from heat, flame, and waxes. Carbon tetrachloride reacts with chemically active metals and mixtures of ethylene and benzoyl peroxide to make fires and explosions. It is also not compatible with oxidizing agents.

If carbon tetrachloride is spilled or leaked:

- Evacuate everyone, and secure and control the entrance to the area.
- Remove all ignition sources.
- Only clean up the spill if you are properly trained and equipped to do so.
- Absorb the spill using vermiculate, dry sand, earth, or similar material.
- Collect the contaminated spill material and place into sealed containers.
- After cleanup is complete, ventilate and wash the area.
- Carbon tetrachloride may need to be contained and disposed of as a hazardous waste. Contact your state environmental department or EPA regional office for questions about proper disposal.



"...always wear the proper personal protective equipment (PPE)..."



Fun Page

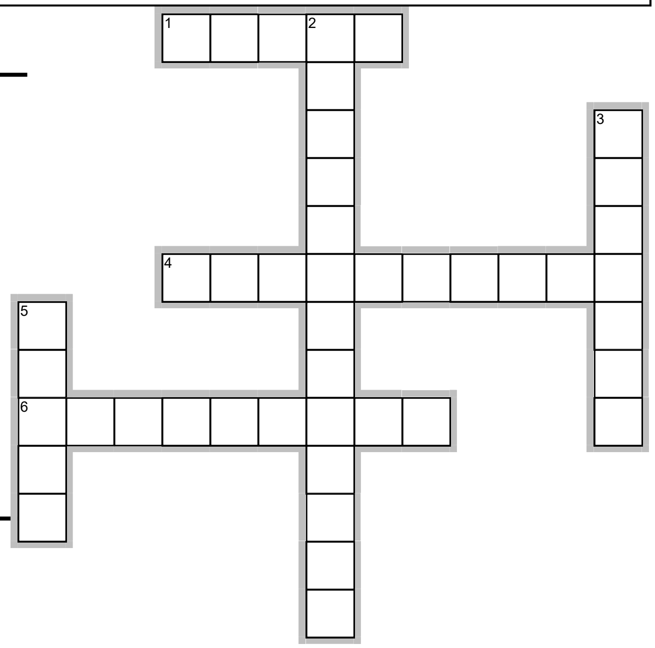
F U N P A G E

Across

1. Always secure cylinders when in use, in storage, _______, and in transport.
4. __________ workers had the most electrocutions per year.......
6. Keep potentially ________ plants, like mistletoe, away from children.

Down

2. Carbon ______________ is a manufactured chemical that is a clear liquid with a sweet smell.
3. Approximately 36.5% of all deaths in the workplace occurred due to employees __________.
5. For a sufficient condensation of the vapor, in a vacuum pump, you should set the cooling temperature at about 20°C lower than the ________ temperature.

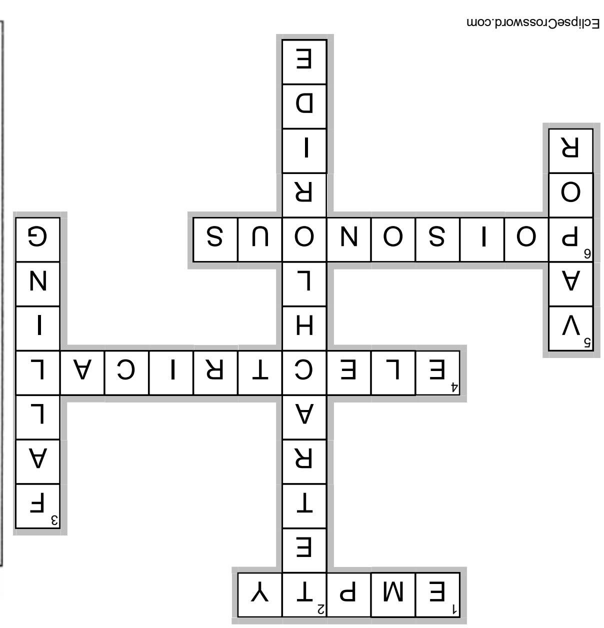


EclipseCrossword.com

Funny Corner

"Wait. Are you sure this is a good idea?"

Puzzle Answers



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Safety Quotes

Prepare and prevent, don't repair and repent.

~Author Unknown

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