

# **Hazardous Materials**

## **OSHA 10-hour Outreach Training General Industry**

# Introduction

## Lesson objectives:

1. Identify types of hazardous materials and how exposures can occur.
2. Identify hazards associated with hazardous materials, including injuries that may occur.
3. Describe methods for eliminating physical hazards of hazardous materials.
4. Describe methods for eliminating health hazards of hazardous materials.

# What's in it for you?



Source: Construction Safety Council, used with permission.

# Exposure to Hazardous Materials

What are hazardous materials?

- Group of products for which the storage, handling, and use are regulated under the Hazardous Materials standard
- Primarily associated with physical hazard
- May also pose health hazard

# Exposure to Hazardous Materials

## Examples of worksite exposure:

- Operations involving the storage, handling, and/or use of:
  - Compressed gases
    - Liquefied gases – anhydrous ammonia, chlorine, propane, nitrous oxide, and carbon dioxide
    - Non-liquefied gases – oxygen, nitrogen, helium, and argon
    - Dissolved gases - acetylene

# Exposure to Hazardous Materials

- Flammable liquids
  - Category 1 – ethyl ether, isopentane, propylene oxide
  - Category 2 – acetone, benzene, ethyl alcohol, gasoline isopropyl alcohol, toluene
  - Category 3 – naphtha, turpentine, xylene
  - Category 4 – ethylene glycol, glycerine
- Cryogenics and refrigerated liquids – oxygen, nitrogen, argon, hydrogen, helium LNG, Liquid methane, carbon monoxide
- Liquefied petroleum gases (LPGs) – propane, propylene, butane, and butylene
- Explosives and blasting agents

# Exposure to Hazardous Materials

- Spray finishing operations
- Dipping and coating operations
- Processing of highly hazardous chemicals
- Clean-up and management of hazardous waste operations and emergency response



Source: OSHA; courtesy of U.S. Air Force



Source: FEMA; S. Shapira

# Exposure to Hazardous Materials

Additional precautions for hazard exposures:

- Hazardous (classified) locations
- Confined spaces



Source: OSHA

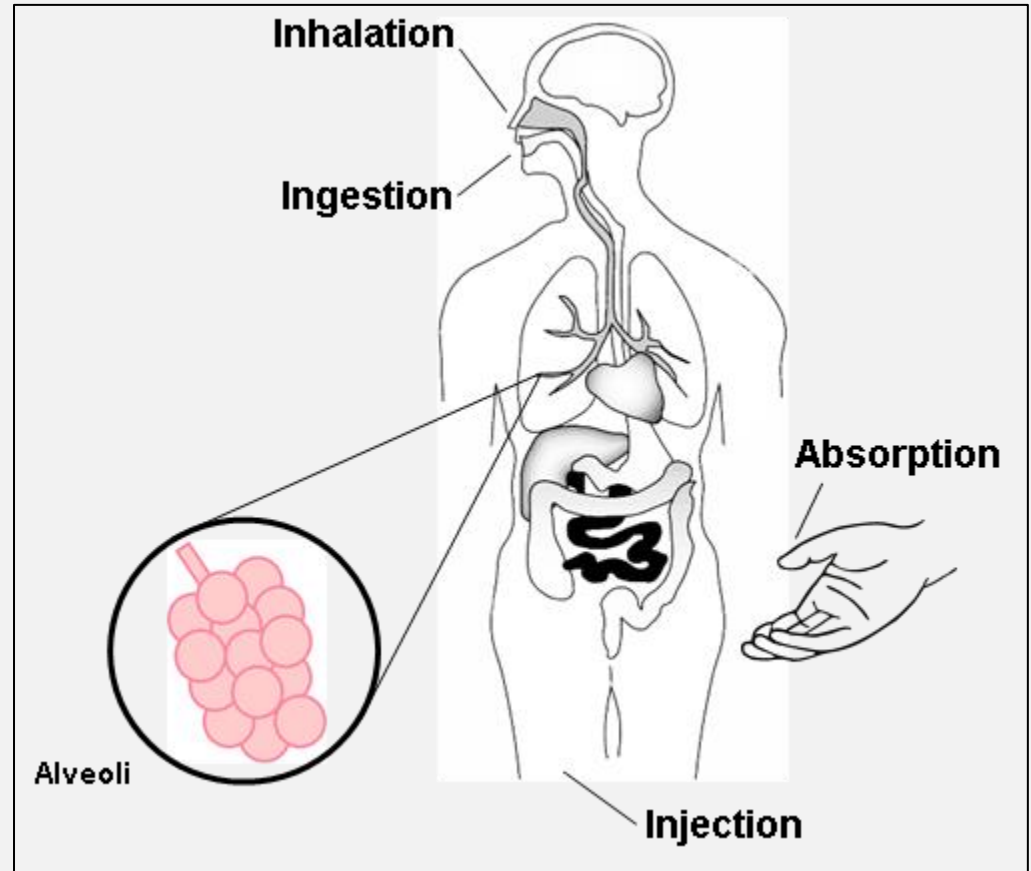


# Exposure to Hazardous Materials

Routes of entry:

- Inhalation\*
- Ingestion
- Absorption
- Injection

\* Most Common

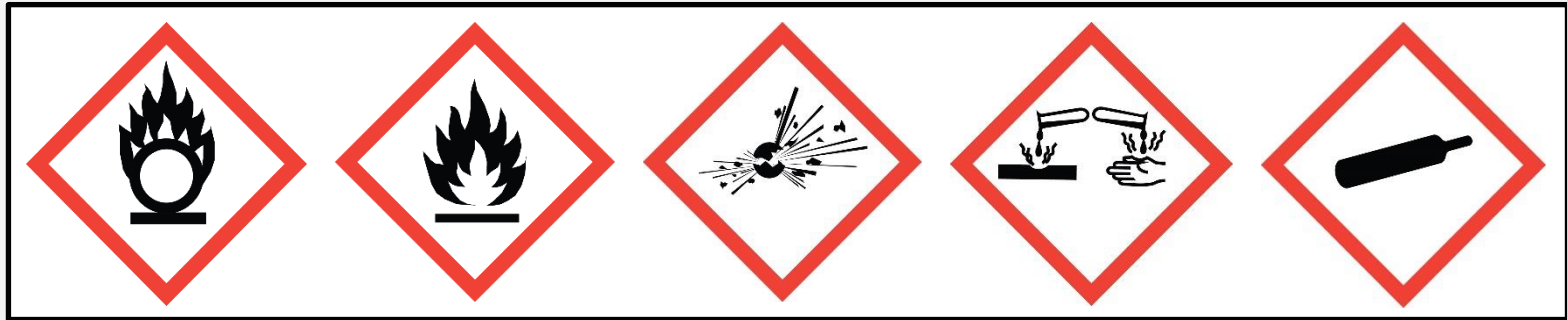


Source: Construction Safety Council, used with permission.

# Hazards of Hazardous Materials

Types of **physical hazards** associated with hazardous materials:

- Oxidizer
- **Flammable**
- **Explosion**
- Corrosive to metal
- **High-pressure systems**



Source of pictograms: OSHA

# Hazards of Hazardous Materials

Types of **health hazards** associated with hazardous materials:

- **Acute/chronic toxicity**
- **Skin corrosion or irritation**
- **Aspiration hazard**
- Serious eye damage or eye irritation
- Respiratory or skin sensitization
- Germ cell mutagenicity
- Carcinogenicity
- Reproductive toxicity
- Specific target organ toxicity



Source of pictograms: OSHA

# Hazards of Hazardous Materials

## Compressed gases:

- Oxygen displacement
- Fires
- Explosion
- Toxic gas exposures
- Physical hazards associated with high pressure systems



Source: OSHA

# Hazards of Hazardous Materials

Cryogenic and refrigerated liquids:

- Extreme cold
- Extreme pressure
- Asphyxiation
- Fire or explosion



Source: OSHA

# Hazards of Hazardous Materials

## Flammable liquids:

- Fire
- Explosion



Source: OSHA

29 CFR 1910.1200  
Appendix B, B.6.2

| Criteria for Flammable Liquids |  |
|--------------------------------|--|
| Category                       | Criteria   |
| 1                              | Flashpoint < 73.4°F and initial boiling point ≤ 95°F |
| 2                              | Flashpoint < 73.4°F and initial boiling point > 95°F |
| 3                              | Flashpoint ≥ 73.4°F and ≤ 140°F                      |
| 4                              | Flashpoint > 140°F and ≤ 199.4°F                     |

# Hazards of Hazardous Materials

## Spray finishing:



- Flammable/combustible materials
- Health hazards
- Example: Isocyanates
  - Powerful irritant to eyes and gastrointestinal and respiratory tracts
  - Inflammation to skin



Source of photos: NIOSH

# Hazards of Hazardous Materials

## Liquefied petroleum gases (LPG):

- Pictograms:  
- Signal word: Danger
- Hazard statements:
  - Extremely flammable gas.
  - Contains gas under pressure; may explode if heated.
  - May cause frostbite.
  - May form explosive mixtures in air.
  - May displace oxygen and cause rapid suffocation.







Source: OSHA



# Hazards of Hazardous Materials

## Anhydrous ammonia:

- Pictograms:    
- Signal word: Danger
- Hazard statements
  - Flammable Gas
  - Contains gas under pressure
  - May explode if heated
  - Toxic if inhaled
  - Causes severe skin burns and eye damage
  - Corrosive to respiratory tract



Source of photos: OSHA

# Hazards of Hazardous Materials

## Hazardous (classified) locations:

- Class I – flammable gases or vapors
  - Division 1
  - Division 2
- Class II – combustible dust
  - Division 1
  - Division 2
- Class III – ignitable fibers or flyings

# Hazards of Hazardous Materials

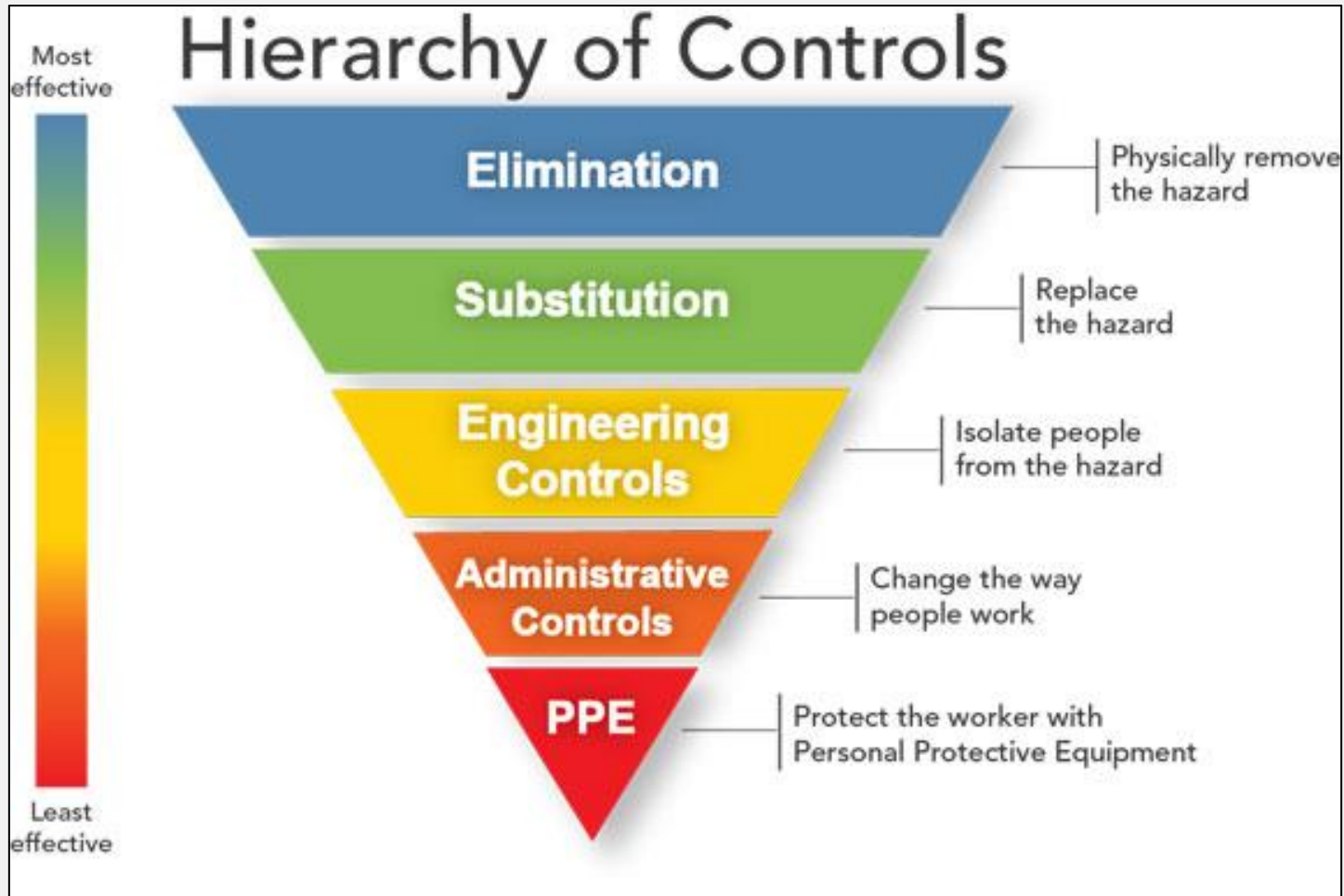
## Confined spaces:

- Limited or restricted means for entry/exit; not designed for continuous occupancy
- PRCS contains or has potential to contain hazardous atmospheres



Source of photos: OSHA

# Controlling Physical Hazards



Source: NIOSH

# Controlling Physical Hazards

## Compressed gases:

- Compressed gas cylinders shall be in a safe condition to the extent that this can be determined by visual inspection.



Source of graphics: OSHA

# Controlling Physical Hazards

## Safety can:

- Not more than 5 gallons capacity
- Spring-closing lid
- Designed to relieve internal pressure when subjected to fire.



Source of photos: OSHA

# Controlling Physical Hazards

## Cabinets:

- Not more than 60 gallons of Category 1, 2, or 3 flammable liquids, nor more than 120 gallons of Category 4 flammable liquids.
- Suitable fire control devices shall be available at locations where flammable liquids are stored.



Source of photos: OSHA

# Controlling Physical Hazards

## Ventilation:

- Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 °F (37.8 °C), shall be ventilated at a rate of not less than 1 cubic foot per minute per square foot of solid floor area.



# Controlling Physical Hazards

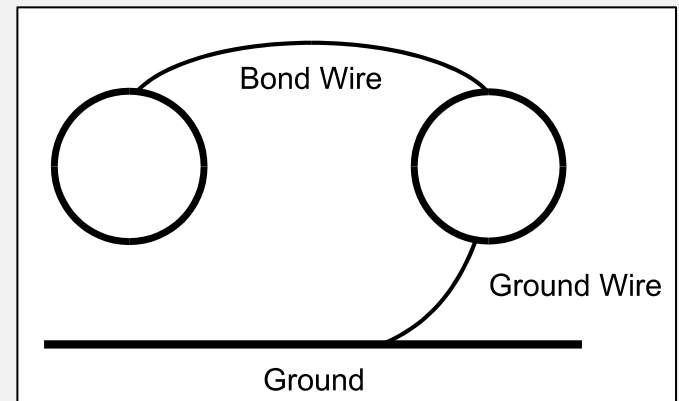
## Explosion-proof apparatus:

- Apparatus enclosed in a case that is capable of withstanding an explosion of a specified gas or vapor that may occur within it and of preventing the ignition of a specified gas or vapor surrounding the enclosure by sparks, flashes or explosion of the gas or vapor within, and that operates at such an external temperature that it will not ignite a surrounding flammable atmosphere.

# Controlling Physical Hazards

## Grounding:

- Category 1 or 2 flammable liquids, or Category 3 flammable liquids with a flashpoint below 100 °F (37.8 °C), shall not be dispensed into containers unless the nozzle and container are electrically interconnected.



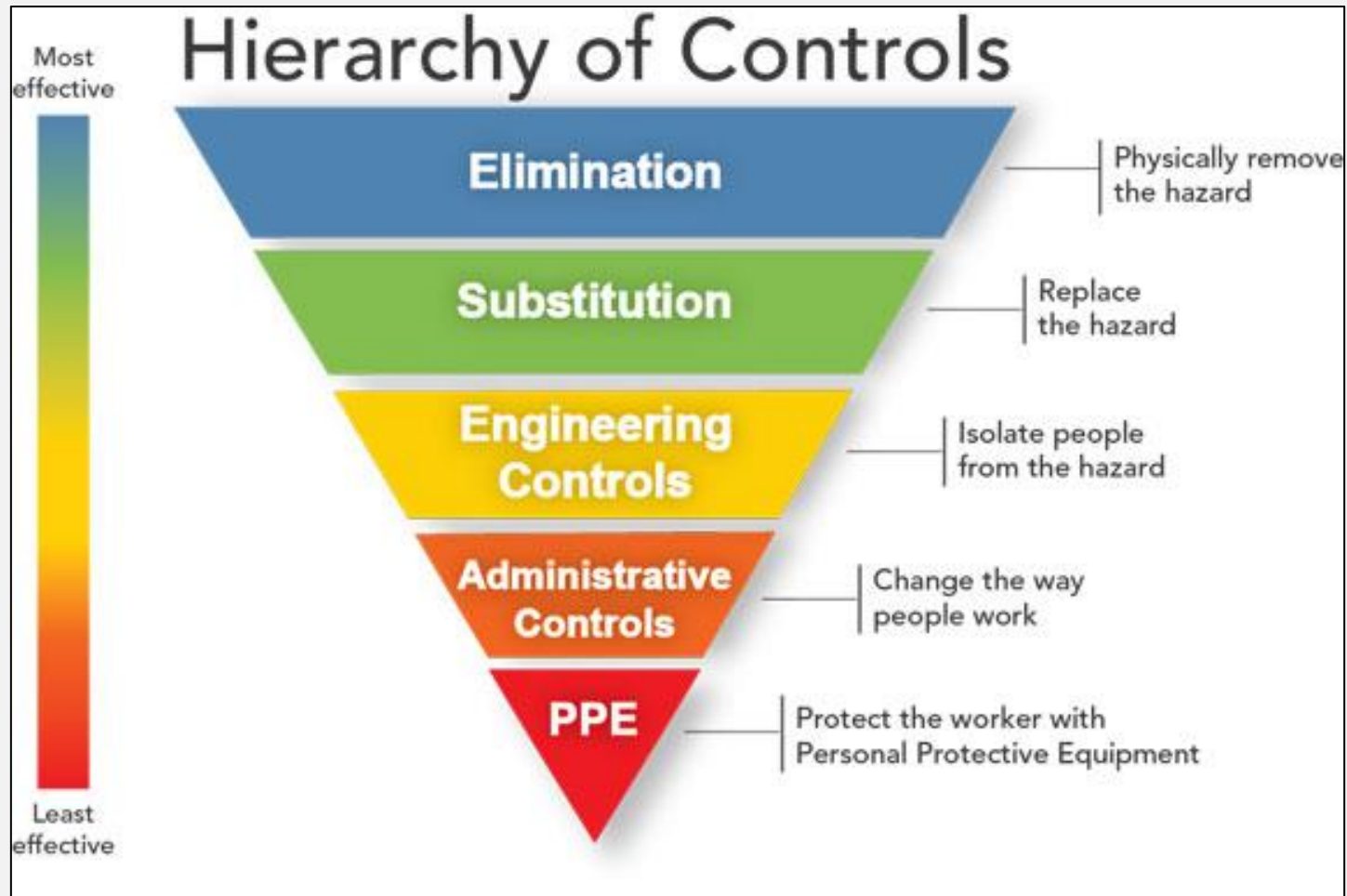
Source of graphics: OSHA

# Controlling Physical Hazards

## Intrinsically safe:

- An apparatus/equipment in which all the circuits in which any spark or thermal effect is incapable of causing ignition of a mixture of flammable or combustible material in air.

# Controlling Health Hazards



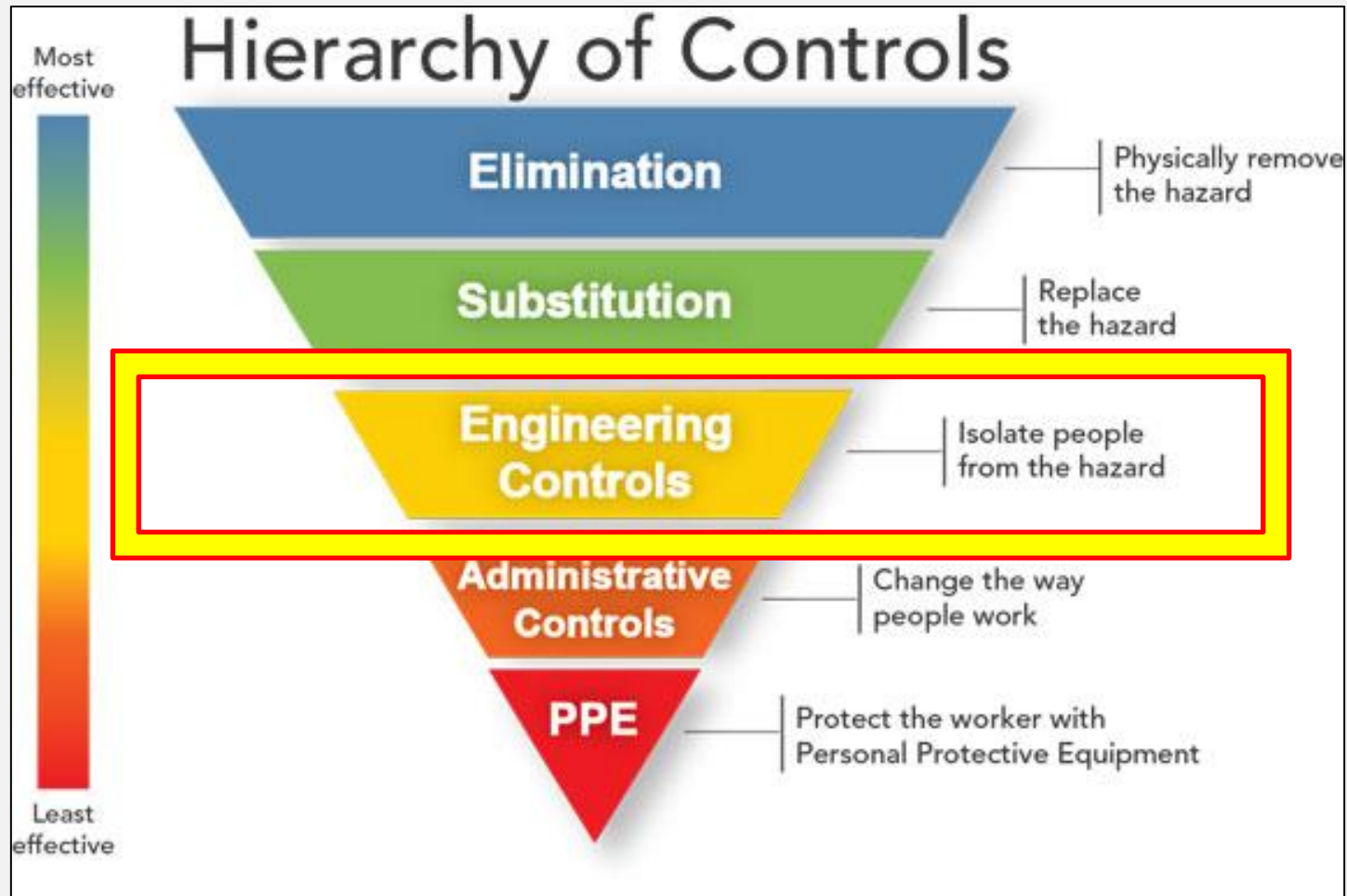
Source: NIOSH

# Controlling Health Hazards



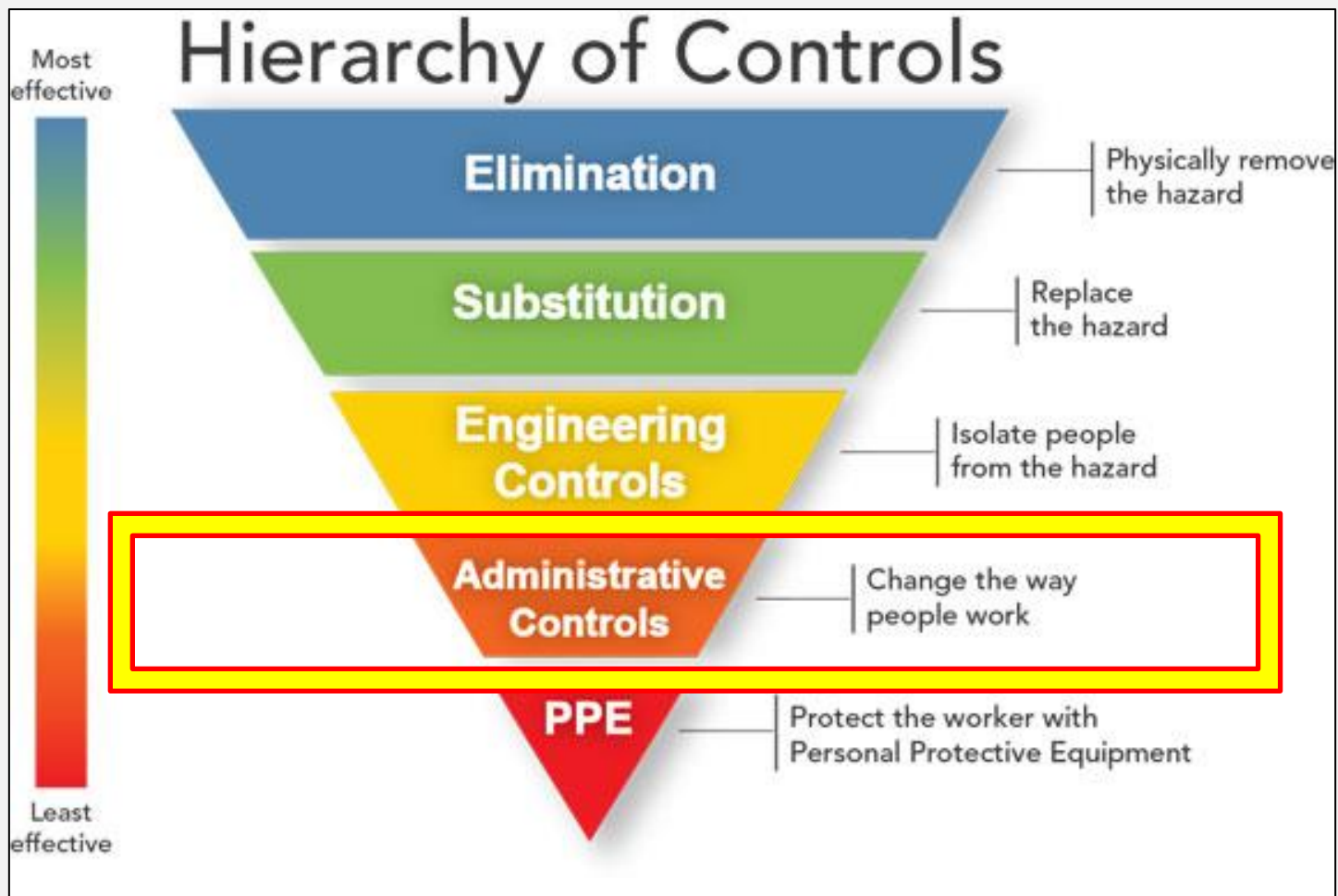
Source: OSHA

# Controlling Health Hazards



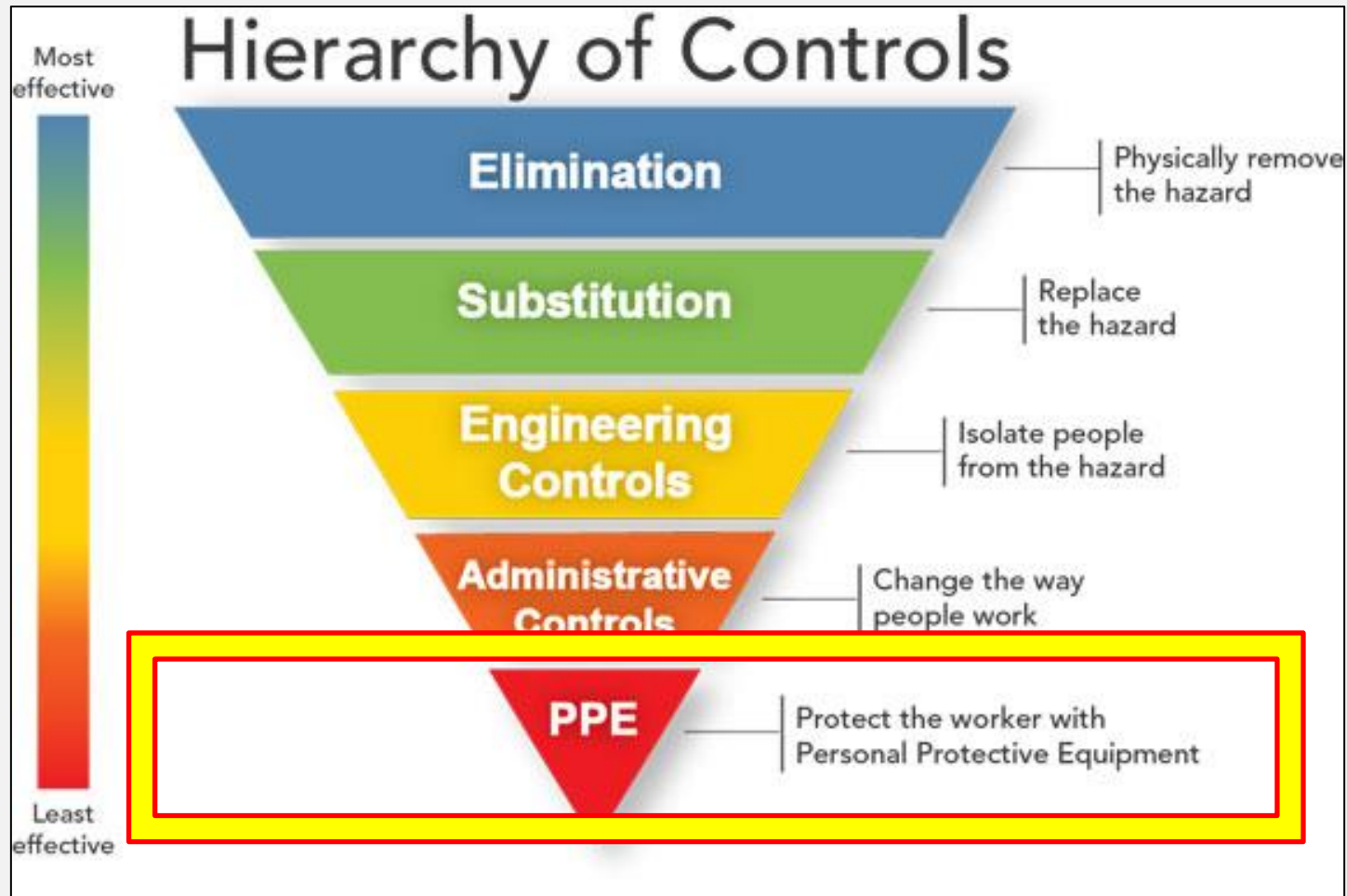
Source: NIOSH

# Controlling Health Hazards



Source: NIOSH

# Controlling Health Hazards



Source: NIOSH



# Controlling Health Hazards

Process Safety Management (PSM) of highly hazardous chemicals:

- Regulations designed to prevent the release of toxic, reactive, flammable and/or explosive chemicals.
- Contains a list and threshold limits for when employers must comply.
  - Anhydrous Ammonia - 10,000 lbs
  - Chlorine - 1,500 lbs

# Controlling Health Hazards

Hazardous Waste Operations and Emergency Response (HAZWOPER):

- Applies to employers and their employees who are exposed to hazardous substances and who are engaged in several operations including clean-up, treatment, storage and disposal of hazardous waste.

# Hazardous Materials Worksheet

Complete the Worksheet

# Hazardous Materials Worksheet

## Hazard Anticipation

### **Anticipated or Potential Hazardous Materials (Check all that Apply):**

- Gases     Vapors     Fumes     Dusts     Fibers     Mists

### **Anticipated or Potential Physical Hazards (Check all that Apply):**

- Fire     Explosion     Oxidizer     Corrosive to Metal     Gas under Pressure     Self-Heating Substance

### **Anticipated or Potential Health Hazards (Check all that Apply):**

- Toxic     Skin/Eye Irritant     Respiratory/Aspiration Hazard     Carcinogen     Reproductive Toxicity

- |  |  |
|--|--|
| <input type="checkbox"/> Confined or enclosed spaces (hazardous atmospheres).  | <input type="checkbox"/> Homes built before 1978 – suspect to contain lead-based paint, according to the EPA.          |
| <input type="checkbox"/> Contaminated soil conditions (hazardous atmospheres).   | <input type="checkbox"/> Extreme temperatures (hot & cold environments).   |
| <input type="checkbox"/> Unsanitary conditions (poor housekeeping, poorly kept toilet facilities, etc.).   | <input type="checkbox"/> Radiological exposures (nuclear power plants, antennas, hospitals, laboratories and the sun). |
| <input type="checkbox"/> Presence of hazardous materials (dangerous coatings on structures & metal containing alloys).                               | <input type="checkbox"/> Loud noise (use of tools and equipment).  |
| <input type="checkbox"/> The use of hazardous chemicals (gases, solvents, glues and concrete).   | <input type="checkbox"/> Hot work (welding and cutting).   |
| <input type="checkbox"/> The presence of residues left by degreasing agents, usually chlorinated hydrocarbons (chloroform and carbon tetrachloride). | <input type="checkbox"/> The presence of plant and/or animal wildlife (poisonous venom, feces, rabies...).             |
| <input type="checkbox"/> Older buildings and structures; unoccupied dwellings (fungi/mold, asbestos & lead).   | <input type="checkbox"/> Other: _____  |

Source: Construction Safety Council, used with permission.

# Hazardous Materials Worksheet

## Hazards Identification

|   |                                      |                               |                                     |                               |                                       |
|---|--------------------------------------|-------------------------------|-------------------------------------|-------------------------------|---------------------------------------|
| <b>Description of Health Hazard:</b> _____  |                                      |                               |                                     |                               |                                       |
| <input type="checkbox"/> Gas  | <input type="checkbox"/> Vapor       | <input type="checkbox"/> Fume | <input type="checkbox"/> Dust/Fiber | <input type="checkbox"/> Mist | <input type="checkbox"/> Fungi (Mold) |
| <input type="checkbox"/> Radiation  | <input type="checkbox"/> Other _____ |                               |                                     |                               |                                       |
| C.A.S # _____   | Flash Point (FP) _____               | Vapor/Gas Density _____       | Lower Flammable Limit (LFL) _____   |                               |                                       |
| PEL: _____  | TLV: _____                           | REL: _____                    | AL: _____                           | C: _____                      | STEL: _____                           |
| <hr/>   |                                      |                               |                                     |                               |                                       |
| ➤ Is there a safe alternative? Yes/No (If yes, describe: _____)   |                                      |                               |                                     |                               |                                       |
| ➤ Is the work being performed by qualified people? Yes/No (List special training, certification and/or licensing required): _____ |                                      |                               |                                     |                               |                                       |
| ➤ Does the work involve entry into confined or enclosed spaces? Yes/No (if yes, follow confined space entry procedures).          |                                      |                               |                                     |                               |                                       |
| ➤ Is there a Safety Data Sheet (SDS) available on the job-site for all hazardous chemicals? Yes/No                                |                                      |                               |                                     |                               |                                       |
| ➤ Are hazard controls being implemented in order of preference? Yes/No  |                                      |                               |                                     |                               |                                       |
| 1. Engineering; ventilation & wet methods.  |                                      |                               |                                     |                               |                                       |
| 2. Administrative; work practices, scheduling workers to minimize exposure, extended breaks, etc.                                 |                                      |                               |                                     |                               |                                       |
| 3. Personal Protective Equipment (PPE); respiratory and hearing protection, protection of face, hand, feet, eyes & whole body.    |                                      |                               |                                     |                               |                                       |

Source: Construction Safety Council, used with permission.

# Hazardous Materials Worksheet

## Hazards Evaluation

### **Health Hazard Route of Entry(s)**

Inhalation    Ingestion    Absorption    Injection    Other \_\_\_\_\_

### **Environmental & Personal Air Monitoring:**

- Air monitoring does not measure you or what you are doing, but rather what you are exposed to on the job.
- Air monitoring must be done by a trained health professional (industrial hygienist or technician).
- Monitoring can be done by measuring the air in a fixed location in the work area (*area monitoring*) or by placing the monitoring equipment on individual workers and measuring the amount they are exposed to (*personal monitoring*).|

### **Hazard Evaluation (Employee Exposure Monitoring and/or Medical Surveillance)**

- Exposure Records: TWA: \_\_\_\_\_ C: \_\_\_\_\_ STEL: \_\_\_\_\_  
(This information must be maintained by employer for 30 years.)
- Medical Records (List): \_\_\_\_\_

(This information must be maintained by employer for duration of employment, plus 30 years.)

Source: Construction Safety Council, used with permission.

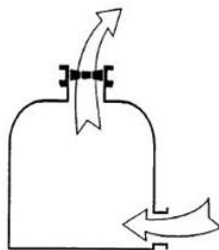
# Hazardous Materials Worksheet

## Hazards Controls - Engineering

**Engineering Controls (Select engineering controls to be implemented):**

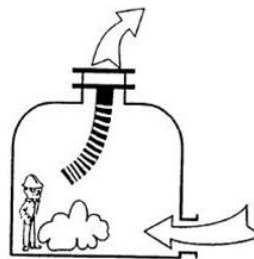
- Dust suppression (*wet methods*): \_\_\_\_\_
- Dust collection systems (*vacuum*): \_\_\_\_\_
- General (dilution) ventilation; works best when air contaminants are widely disbursed through the area.
- Local (exhaust) ventilation system; works well when air contaminants are generated at a single source.

*Describe mechanical ventilation system used:*



### **General (Dilution) Ventilation...**

*Forces fresh air into an area and dilutes contaminants; this allows air to move through a space which ensures a fresh continual supply.*



### **Local (Exhaust) Ventilation...**

*Removes contaminated air at its source; this prevents harmful dust, fumes & mists from contaminating the breathing air of the worker.*

If no engineering controls are being implemented, person authorizing the non-use of engineering controls:

Name: \_\_\_\_\_

Date: \_\_\_\_\_

Reason (explain): \_\_\_\_\_

Source: Construction Safety Council, used with permission.

# Hazardous Materials Worksheet

## Hazards Controls - Administrative

### ***Administrative Controls (used with personal protective equipment):***

- Gather all specialty equipment, including, ventilators, warning signs, personal protective equipment, etc. (list all specialty equipment needed for job): \_\_\_\_\_
- Operations that involve toxic substances are scheduled at times when other workers are not present? Yes/No (describe): \_\_\_\_\_
- Work is isolated to just a few protected employees; signs posted and controlled access zones established? Yes/No (describe): \_\_\_\_\_
- Employees are rotated in and out of jobs to minimize exposure? Yes/No (describe):  
\_\_\_\_\_
- Employees removed from working around hazardous substances once they have reached a predetermined level of exposure? Yes/No (describe): \_\_\_\_\_
- Are hot and cold work environments considered? Yes/No (describe): \_\_\_\_\_
- Employees trained on proper housekeeping & good personal hygiene? Yes/No
- Employees trained on the proper procedures that minimize exposures? Yes/No
- Employees trained on how to inspect and maintain process and equipment on a regular basis? Yes/No
- No eating, drinking, smoking, chewing tobacco or gum, and applying cosmetics in hazardous areas? Yes/No

Source: Construction Safety Council, used with permission.



# Hazardous Materials Worksheet

## Hazards Controls - PPE

Controlling a hazard at its source is the best way to protect workers. However, when engineering, work practices and administrative controls are not feasible\* or do not provide sufficient protection, employers must provide **personal protective equipment (PPE)** to the employee and ensure its proper use.

**Description of personal protective equipment being used:**     Eye/Face Protection     Foot Protection  
 Body Protection     Gloves     Respirator     Other \_\_\_\_\_     Other \_\_\_\_\_

- Is the device approved? Yes/No (describe): \_\_\_\_\_
- Is the device appropriate for the type of hazard? Yes/No (explain): \_\_\_\_\_
- Is the worker wearing the device properly trained to understand the use, limitations and care instructions of the device? Yes/No (explain): \_\_\_\_\_
- Does the material have sufficient strength to withstand the environment? Yes/No (explain):  
\_\_\_\_\_
- Will the material withstand repeated use after contamination and decontamination? Yes/No (explain):  
\_\_\_\_\_
- Is the material flexible or pliable enough to allow end users to perform needed tasks? Yes/No (describe):  
\_\_\_\_\_
- Will the material maintain its protective integrity and flexibility under hot and cold extremes? Yes/No (explain):  
\_\_\_\_\_

Source: Construction Safety Council, used with permission.

# Summary

***Stop health hazards before they stop you!***



Source: Construction Safety Council, used with permission.

# Knowledge Check

1. The most common route of entry by which hazardous materials are introduced into the body is \_\_\_\_.
  - a. inhalation
  - b. absorption
  - c. ingestion
  - d. injection

**Answer: a. inhalation**

# Knowledge Check

2. Flammability is which type of hazard?
- a. Carcinogenic
  - b. Health
  - c. Physical
  - d. Mutagenic

**Answer: c. Physical**

# Knowledge Check

3. Which of the following hazards is an example of a physical hazard?
- a. Oxidizer
  - b. Exposure to carcinogen
  - c. Chronic toxicity
  - d. Acute toxicity

**Answer: a. Oxidizer**

# Knowledge Check

4. Which of the following hazards is an example of a health hazard?
- a. Fire hazard
  - b. Acute toxicity
  - c. Explosive
  - d. High pressure

**Answer: b. Acute toxicity**

# Knowledge Check

5. Which of the following is the preferred order of controlling hazards, or “hierarchy of controls,” for hazardous materials?
- a. PPE, Administrative Controls, Engineering Controls, Elimination
  - b. Administrative Controls, Engineering Controls, Elimination, PPE
  - c. Engineering Controls, Elimination, PPE, Administrative Controls
  - d. Elimination, Engineering Controls, Administrative Controls, PPE

**Answer: d. Elimination, Engineering Controls, Administrative Controls, PPE**

# Knowledge Check

6. When transferring a flammable liquid from one container to another, the containers should be \_\_\_\_ to prevent static electricity from creating a fire hazard.
- a. ventilated or pressurized
  - b. ventilated and pressurized
  - c. bonded or grounded
  - d. bonded and grounded

**Answer: d. bonded and grounded**



# Knowledge Check

7. Which of the following hazard controls is an example of an engineering control?
- a. Enclosing an operation to prevent contact with the hazardous material
  - b. Training employees on the proper handling and storage of a hazardous material
  - c. Implementing a procedure for the proper use of a hazardous material
  - d. Requiring personal protective equipment to be worn when working with a hazardous material

**Answer: a. Enclosing an operation to prevent contact with the hazardous material**