

## HAZARDOUS MATERIALS

Hazardous Substance Safety, OSHA Hazard Communication Standard, DOT Hazardous Material Regulations, Healthcare Hazardous Materials, Medical Gas Systems, Respiratory Protection.

### 3.1 INTRODUCTION

**P1**

Healthcare organizations use a wide variety of hazardous substances, including disinfectants, sterilizing agents, solvents, chemotherapeutic drugs, compressed gases, and hazardous wastes. Occupational Safety and Health Administration (OSHA), EPA, Department of Transportation (DOT), and accreditation organizations, including the Joint Commission, require healthcare organizations to properly receive, handle, manage, and dispose of hazardous materials in an effective manner.

### 3.1 HAZARDOUS SUBSTANCE SAFETY

- Identify and mitigate risks associated with selecting, handling, storing, transporting, using and disposing of chemicals, dangerous medications, and hazardous gases or vapors.
- Label hazardous materials and wastes to identify the contents and provide hazard warnings.
- Trained workers know how to safely handle, store, use, and segregate hazardous materials and waste products.
- The OSHA HCS, 29 CFR 1910.1200, specifies education and training for users of hazardous chemicals

#### Hazardous Substance Exposures

**P2**

- Toxic substances can enter the body through the skin, respiratory system, mouth, and eyes.
- Some substances can also damage the skin or eyes directly without being absorbed.
- A person can inhale or swallow inorganic lead, but it does not penetrate the skin.
- Exposures to hazardous materials can cause stress on the body if inhaled, absorbed, or ingested, concentration, duration of exposure, route of exposure, physical and chemical properties.
- Other chemicals, physical agents, and the general health of the person exposed can influence the effects exerted by a hazardous substance.

#### Hazardous Chemical Determination

- A substance is said to be hazardous if regulated by
  - OSHA in 29 CFR Parts 1910, Subpart Z,
  - ACGIH Documentation of the Threshold Limit Values
  - Biological Exposure Indices as hazardous.
  - International Agency on Research on Cancer
  - IARC Monographs
  - The National Toxicology Program ( carcinogen)

#### Reproductive Hazards

- The reproductive health of women or men is damaged due to chemical, physical, or biological hazards.
- Reproductive hazard exposure can occur by inhalation, skin contact, and ingestion.

- Potential health effects can include infertility, miscarriage, birth defects, and child development.
- Organizations must work to limit exposures by the use of workplace engineering controls, proper work practices, and good hygiene practices.
- Current scientific evidence suggests that chronic exposure to anesthetic gases increases the risk of congenital abnormalities in offspring among female workers.
- The “Effects of Workplace Hazards on Female Reproductive Health,” NIOSH Publication No. 99-104, addresses exposure, prevention, and reproductive hazards for female workers and their unborn babies.
- The “Effects of Workplace Hazards on Male Reproductive Health,” NIOSH Publication No. 96-13, identifies steps to reduce or prevent workplace exposure to male reproductive hazards.

### **Threshold Limit Values**

- Published by ACGIH, threshold limit values (TLVs) represent the opinion of the scientific community for the purpose of encouraging exposure at or below the level of a published TLV.
- The values serve as guidelines and not as standards.
- TLVs help industrial hygienists make decisions regarding safe levels of exposure to various chemical or physical agents found in the workplace.

### **Chemical Properties**

- Chemical properties describe the reactivity of a substance with other chemicals.
- Reactive substances can burn, explode, or give off hazardous vapors when mixed with other chemicals or when exposed to air or water.
- Oxidizing chemicals easily release oxygen that can fuel fires when stored near flammable substances.
- Oxidizers cause other materials to burn even though most oxidizers won't burn themselves.
- Ensure storage is away from heat sources because warming causes oxygen release that can create the perfect environment for a fire.
- Corrosive chemicals can eat through other materials, including human skin.
- Irritants such as ammonia possess corrosive characteristics that attack mucous membranes in the nose and mouth.

### **Flash Points**

- According to NFPA 30, Class I flammable liquids possess a flash point of less than 100°F (38°C) while combustible liquids possess a flash point of 100°F (38°C) or more.
- When vapors combine with oxygen in the air, will ignite easily and burn rapidly with explosive force.
- Vapor density relates to the ratio of the weight of a volume of vapor or gas to the weight of an equal volume of clean but dry air.
- SDSs contain vapor densities for the chemical substances. Knowing the vapor density can tell you how a vapor will act.
- A vapor density < 1.0 will tend to rise and spread out.
- A vapor density of 1.0 or more will tend to sink to the lowest point on the ground and find ignition sources such as chemicals with high vapor densities particularly dangerous.

- **EG:** Consider an ignition source that causes something to burn. Common ignition sources include sparks from tools and equipment; open flames such as torches, smoking materials, and pilot lights, hot particles and hot surfaces such as electric coils.
- Flowing liquid chemical creates static electricity. Grounding ensures that an electrical charge goes to the ground rather than building up on the drum of flammable or combustible material.
- Bonding refers to a process that equalizes the electrical charge between the drum and the transfer container.
- This prevents the buildup of electrical charges on one of the containers.
- Ignition temperature refers to the minimum temperature at which a chemical will burn and continue burning without the need for an ignition source.
- Difference between flammable and explosive refers to combustion or the speed at which a material burns. A fire results from a rapid release of energy. An explosion occurs when an instantaneous release of energy involves an extremely rapid rate of combustion.

### **Airborne Exposure**

- An exposure of an individual relates directly to the concentration of a hazardous substance as related to the per-unit volume of air.
- Express airborne concentrations in terms of milligrams of substance per cubic meter of air (mg/m<sup>3</sup>) or parts of substance per million parts of air (ppm).
- OSHA requires consideration of feasible administrative or engineering controls to reduce exposure risks.
- When these controls prove ineffective, organizations must use PPE or other protective measures to protect employees.
- Ensure that the use of any equipment and/or technical measures receive approval from a competent industrial hygienist or other technically qualified person.

### **OSHA additive formula**

- OSHA provides an additive formula in 29 CFR 1910.1000 for computing exposure to a substance containing two or more hazardous ingredients.
- Employers must monitor and compute the equivalent exposure using the following formula:
  - E (m) is the equivalent exposure for the mixture
  - C is the concentration of a particular contaminant
  - L is the exposure limit for that substance specified in Subpart Z
  - Value of E (m) shall not exceed unity (1)
- To illustrate the formula consider the following exposures:
  - Substance A—actual exposure at 500 ppm with a PEL of 1000 ppm
  - Substance B—actual exposure at 45 ppm with a PEL of 200 ppm
  - Substance C—actual exposure at 40 ppm with a PEL of 200 ppm
- Substituting the exposure values into the formula achieves the following results:
  - $E (m) = 500 \text{ divided by } 1000 + 45 \text{ divided by } 200 + 40 \text{ divided by } 200$
  - $E (m) = 0.500 + 0.225 + 0.200$

- $E(m) = 0.925$

Since  $E(m)$  is less than the unity (1), the exposure combination is within acceptable limits. If the value exceeds one (1), consider the exposure as above the acceptable limit.

### **Emergency Showers and Eyewashes**

- OSHA standard (29 CFR 1910.151) requires employers to provide suitable facilities for quick drenching of the eyes and body for individuals exposed to corrosive materials.
- Organizations should ensure that flushing fluids remain clear and free from foreign particles.
- Self-contained eyewash stations should be drained completely, disinfected, and rinsed prior to refilling.
- Personal eye-wash bottles can provide immediate flushing when located in hazardous areas.
- However, personal eyewash equipment does not meet the requirements of plumbed or gravity-feed eyewash equipment.
- Personal eyewash units can support plumbed or gravity-fed eyewash units but cannot serve as a substitute.
- Preservatives can help control bacteria levels in flushing fluids.
- A preservative's performance depends upon several factors, including the initial bacterial load of the water and a potential biofilm in the station.
- Always inspect and test the unit if you doubt its dependability. Identify problems or concerns and establish regular maintenance procedures.
- Consult the manufacturer's operating manual and ANSI Z358.1 for assistance in performing test procedures, maintenance operations, and training.

### **Basic Requirements for Eyewash and Shower Facilities**

- Valves must activate in 1 s or less.
- Installed in locations 10 s from the hazard.
- Located in a lighted area and identified with a sign.
- Train workers on equipment use and appropriate PPE.
- Activate plumbed units weekly.

### **Compressed Gas Safety**

- The CGA promotes safe work practices for industrial gases and develops safe handling guidelines.
- OSHA regulates the use and safety of compressed gases in the workplace (29 CFR 1910.101) for complete information on inspecting gas cylinders.
- The DOT regulates the transportation of compressed gases by rail, highway, aircraft, and waterway.
- Store compressed gas cylinders in cool and dry areas with good ventilation.
- Never store compressed gas cylinders at temperatures higher than 125°F.
- Do not store cylinders near heat, open flames, or ignition sources.
- Properly label all cylinders, and never remove valve protection caps until securing cylinder for use.
- Comply with OSHA 29 CFR 1910.101–105 and DOT 49 CFR 171–179 standards when handling compressed gases.
- When not in use, close valves and properly secure.

- Use appropriate lifting devices to transport gas cylinders.
- Store cylinders in areas with a fire-resistible partition between oxygen and flammable material.

### **3.2 OSHA HAZARD COMMUNICATION STANDARD (29 CFR 1910.1200) P3**

OSHA requires the development of a written hazard communication plan with address container labeling, SDS availability, and training requirements. Organizations must make the plan available on all shifts with appropriate hazard information to all affected or exposed individuals.

#### **Globally Harmonized System**

- GHS stands for the international approach to hazard communication.
- This global system provides criteria for classifying chemical hazards and standardizing labels and SDS.
- The development of GHS is done by hazard communication experts from different countries, international organizations, and stakeholder groups.
- OSHA requires employers to communicate hazardous materials information to employees. The original performance-oriented standard allowed chemical manufacturers and importers to convey information on labels and SDS in a variety of formats.
- The GHS requires providing detailed criteria for determining what hazardous effects a chemical poses.
- It also requires a standardized label assigned by hazard class and category. This will enhance both employer and worker comprehension of the hazards, resulting in safer use and handling.
- The harmonized format of the SDS will enable employers, workers, health professionals, and emergency responders to access the information more efficiently and effectively.

#### **Major Hazard Communication Standard Changes**

- The definitions of hazard will change to provide specific criteria for the classification of health, physical hazards and classification of mixtures.
- These specific criteria will help ensure that evaluations of hazardous effects remain consistent across manufacturers.
- Chemical manufacturers and importers must provide a label that includes a harmonized signal word, pictogram, and hazard statement for each hazard class and category, precautionary statements
- Finally, the SDS will contain a specified 16-section format.
- OSHA modifies some terms to align the revised standard with language used in the GHS.
- The term hazard determination changed to hazard classification and material safety data sheet changed to safety data sheet.
- Evaluation of chemical hazards must use available scientific evidence concerning such hazards.
- The revised standard also establishes both hazard classes and hazard categories that reflect relative severity of the effect.
- Under the original standard, the label preparer provided the identity of the chemical and the appropriate hazard warnings.

- The preparer determined the method to convey the information. The revised standard specifies what information to provide for each hazard class and category.
- The revised standard requires the printing of all red borders on the label with a symbol printed inside.
- Chemical manufacturers, importers, distributors, or employers who become aware of any significant information regarding the hazards of a chemical must revise labels within 6 months of becoming aware of the new information.
- Employers can label workplace containers with the same label affixed to the shipped containers. Employers can also use label alternatives, including those described in NFPA704, Hazard Rating and the Hazardous Material Information System.
- However, the information supplied on alternative labels must meet the requirements of the revised standard with no conflicting hazard warnings or pictograms.

### **New labeling requirements**

**Pictogram:** This method uses a symbol plus other graphic elements, such as a border, background pattern, or color to convey specific information about the hazards of a chemical. Each pictogram consists of a different symbol on a white background within a red square frame set on a point (a red diamond). The system requires the use of nine pictograms. However, OSHA requires the use of only eight pictograms under the revised standard.

**Signal words:** This requirement consists of using a signal word to indicate the relative level of the severity of hazard to alert the reader of a potential hazard. The signal words used include danger and warning. Use danger for severe hazard and warning for less severe hazards.

**Hazard statement:** This requirement consists of a statement assigned to a hazard class and category that describes the nature of the hazards of a chemical. It also includes, as appropriate, the degree of hazard.

**Precautionary statement:** This phrase describes recommended measures to minimize or prevent adverse effects that could result from exposure to a hazardous chemical. It also applies to the improper storage or handling of a hazardous chemical.

### **Safety Data Sheet Changes**

#### **P4**

- The information required on the SDS remains essentially the same as the original standard.
- The original standard requires specific information but did not specify a format for presentation or order of information.
- The revised standard requires presenting the information on the SDS using consistent headings in a specified sequence.
- The SDS format remains the same as the ANSI standard format.
- OSHA plans to retain the requirement to include the ACGIH TLVs on the SDS. OSHA found that requiring TLVs on the SDS will provide employers and employees with useful information to help them assess the hazards presented by their workplaces.
- OSHA will also require the inclusion of PELs and any other exposure limits used or recommended by the chemical manufacturer, importer, or employer preparing the SDS.
- OSHA also included a non-mandatory Appendix F in the revised standard to provide guidance on hazard classification for carcinogenicity.

- Part A of Appendix F includes background guidance provided by GHS based on the “Preamble” of the IARC “Monographs on the Evaluation of Carcinogenic Risks to Humans.” Part B provides IARC classification information. Part C provides background guidance from the National NTP “Report on Carcinogens.”

**Required SDS Information**

Section 1. Identification	Section 9. Physical and chemical properties
Section 2. Hazard(s) identification	Section 10. Stability and reactivity
Section 3. Composition/information ingredients	Section 11. Toxicological information
Section 4. First-aid measures	Section 12. Ecological information
Section 5. Fire-fighting measures	Section 13. Disposal considerations
Section 6. Accidental release measures	Section 14. Transport information
Section 7. Handling and storage	Section 15. Regulatory information
Section 8. Exposure control/personal protection	Section 16. Other information

**Employee Training**

- The OSHA HCS (29 CFR 1910.1200) requires employers to provide employees information and training on hazardous chemicals used in their work areas.
- Employers must conduct training at the time of their initial assignment and upon the introduction of a new hazardous substance.
- Training must address the methods and observations used to detect the presence or release of the chemical.
- It must also address physical and health hazards, protective measures, labeling, and an explanation of the SDS.
- Employers must inform employees of the hazards of non-routine tasks and the hazards associated with chemicals in unlabeled pipes.

**Aspects of Pesticide Regulation That GHS Does Not Affect**

- Implementing GHS does not change most aspects of the pesticide management.
- It does not affect supplemental information required on labels such as directions for use or additional hazard information that does not contradict or detract from GHS label requirements.
- It also does not impact testing methods for health and environmental hazards, data requirements, the scope of hazards covered, policies governing the protection of Confidential Business Information, or risk management measures.

**3.3 DOT HAZARDOUS MATERIAL REGULATIONS**

**P5**

- The secretary of the DOT receives the authority to regulate the transportation of hazardous materials from the Hazardous Materials Transportation Act.
- The Pipeline and Hazardous Materials Safety Administration (PHMSA) holds the responsibility to write the hazardous materials regulations, contained in 49 CFR Parts 100–180.
- The applicability of the hazardous materials regulations now extends to all shipments of hazardous materials by highway.
- Special agents of the DOT cannot be denied reasonable access to those areas that fall within the official scope of their duties.

- The Hazardous Materials Table located in 49 CFR 172.101 provides the initial step toward understanding how to ship a product.
- This table provides the proper shipping name (PSN), hazard class, UN identification numbers, and labels and packaging types necessary. Locate the PSN from the alphabetically arranged Hazardous Materials Table
- Identify the contents of a shipment using shipping papers, markings, labeling, and placard information.
- Refer to the Hazardous Materials Table (49 CFR 172.101). A marking can include handwritten or a preprinted self-adhesive label containing required information such as PSN, the United Nations/North American (UN/NA) identification number, and the consignees or consignor's name and address (49 CFR 172.300). Labeling using a 4" × 4" square-on-point label helps visibly identify a hazardous materials package.
- Consider shipping labels as specific to the hazard classes of materials with strict specifications for setup, including color, size, and wording, as well as placement on a package (49 CFR 172.400–172.450).
- The Hazardous Materials Table contains a label column referencing the label for the specific chemical by the hazard class.
- A label chart that shows hazard class or division and the associated label plus the section reference can be found in 49 CFR 172.400(b).
- When using two labels, the less hazardous of the two is a secondary hazard. This secondary hazard must contain labeling that meets the requirements of 49 CFR 173.402.
- Use Special Precautions Labels such as Empty or Cargo Aircraft Only if required. OSHA standard 29 CFR 1910.1201 requires original DOT labels to remain on vehicles, tanks, and containers until removal or transfer of labeled substances.

### Placards

- Depending on the type and quantity of a shipment, placarding completes the identification process.
- Larger than labels, placards measure 10<sup>3</sup>/<sub>4</sub>" × 10<sup>3</sup>/<sub>4</sub>" but retain a similar square-on-point design.
- Placards deal with a specific hazard class of materials. DOT requires strict specifications for color, size and wording, and placement on a shipping vehicle (49 CFR 172.500.172.560).
- Two tables help determine the requirement for placards (49 CFR 172.504).
- DOT requires placards for secondary hazards (49 CFR 172.519).

### Containers

- Determining the applicable container for shipping a hazardous material depends on the UN identification code on the drum.
- For more information regarding containers, refer to 49 CFR 178.

## 3.4 HEALTHCARE HAZARDOUS MATERIALS

**P6**

### Acetone

- Acetone can be used as a chemical intermediate or as a solvent cleaner.
- It is used in fingernail polish remover, paint-related products.
- It possesses a vapor density twice that of air.
- Inhalation of acetone can result in slight narcosis to respiratory failure.
- Skin should be washed and affected clothing removed immediately when accident occurs.
- In case of eye contact, eyes should be rinsed for 15 min.



- Workers should wear splash goggles and chemical protective gloves made of butyl.

### Acryl Amide

- It is a resin usually found in research labs to make gels for biochemical separations.
- It can cause eye and skin irritation.
- Long-term exposure could result in central nervous system disorders.

### Ammonia

- Ammonia is used as a liquid cleaning agent and as a refrigerant gas.
- Concentrated solutions of ammonia can cause severe burns.
- Workers should avoid skin contact with ammonia by wearing protective clothing.
- Provide adequate ventilation in areas where ammonia gas is released from concentrated solutions.

### Asbestos

- Airborne fibers that cause health damage may be too small to see with the eye.
- Inhaling these airborne asbestos fibers can cause asbestosis, mesothelioma, and lung cancer.
- OSHA regulations require surveillance and record-keeping for workers significantly exposed to asbestos.
- Asbestos is found during routine maintenance activities, renovation projects, and demolition for new construction.
- Workers should work in a sealed environment using appropriate PPE.
- Periodic air sampling, piping and tiles containing asbestos can also exposure risks.
- Maintenance workers and facility engineers can be unknowingly exposed to asbestos from many possible areas and sources.

### OSHA Asbestos General Industry Standard (29 CFR 1910.1001)

- Professional trained personnel can remove the asbestos using methods and protective equipment mandated by OSHA (29 CFR 1910.1001).
- The OSHA asbestos standard should be consulted along with the appropriate NIOSH and EPA publications.
- OSHA outlines work practices appropriate for handling asbestos in 29 CFR 1910.1001. Healthcare organizations must outline OSHA requirements in the facility Asbestos Management Policy.

### OSHA Asbestos Construction Standard (29 CFR 1926.1101)

- The OSHA Construction Standard covers activities such as demolition, removal, repair, or encapsulation of ACM.
- It also covers building maintenance and custodial tasks.
- The Construction Standard divides asbestos work into four types:

<b>Class I asbestos work</b> → activities in which thermal system insulation or surfacing material such as sprayed-on fireproofing is removed.
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<b>Class II asbestos work</b> → removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastics.
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<b>Class III asbestos work</b> → repair and maintenance jobs where ACM (including thermal system insulation or surfacing materials) is likely to be disturbed.
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**Class IV asbestos work**→maintenance and custodial activities employees should contact ACM or PACM and clean up waste containing ACM and PACM.

### **EPA Standards**

- EPA Asbestos-In-Schools Rule (40 CFR Part 763 Subpart E) requires schools to inspect buildings for asbestos and prevent exposure worker/occupant exposure.
- EPA National Emission Standards for Hazardous Air Pollutants (NESHAP 40 CFR 61Subpart M) requires removal of asbestos before demolition removal and waste disposal.

### **Benzene (29 CFR 1910.1028)**

- Benzene, a hazardous solvent found in laboratories, maintenance departments can contribute to dangerous over exposure incidents.
- High levels of exposure can cause acute central nervous system depression. It can also cause eye, skin, and upper respiratory irritation.
- NIOSH considers benzene as a known human carcinogen.
- Personnel must properly store benzene to reduce contact with oxidizing materials such as nitrates, peroxides, and chlorates.

### **Cadmium (29 CFR 1910.1027)**

- Cadmium is a soft, blue and white metal or grayish-white powder commonly used as an anticorrosive for electroplated steel.
- Exposures occur mainly in the gas meter refurbishing, aircraft repair, and in shipyard industries.
- Certain materials and products such as paints, batteries, and phosphate fertilizers also contain cadmium.
- Healthcare safety personnel says the presence of cadmium can occur in lead molds used in radiation medicine.
- Breathing in high levels can cause severe damage to the lungs.
- Short-term effects of exposure include weakness, fever, headaches, chills, sweating, and muscular pain.
- Long-term effects can lead to kidney damage and bone deterioration.
- OSHA requires establishment and implementation of a written plan for cadmium if exposure levels exceed the PEL.

### **Carbon Monoxide**

- Carbon monoxide (CO), a colorless, odorless, and tasteless gas, is slightly lighter than air.
- It is sometimes called carbonic oxide, exhaust gas, or flue gas.
- Sources include laboratories, equipment rooms, boilers, and emergency generators.
- CO in excess can cause of death in fires, coma and death.
- High concentrations will displace enough oxygen in your body, resulting in oxygen starvation.
- Symptoms of low-level CO poisoning include headaches, nausea, weakness, dizziness, and confusion.

### **Chlorine compounds**

- Chlorine is commonly used for sanitizing counter and tabletop surfaces.
- Household bleach commonly used as a disinfecting solution, water tanks cleaning.

- It is used in laundry dishwashing, disinfectant for floors.
- A chlorine-based substance when mixed with materials containing ammonia produces a toxic gas.
- Mild irritation occurs at exposure concentrations of 0.5 ppm.
- Chlorine possesses an odor threshold between 0.02 and 0.2 ppm.

**Iodine**

- Iodine works as a general disinfectant and can be used with alcohol for use as a skin antiseptic or with other substances for general disinfecting purposes.
- Exposure can include irritation of the eyes, headaches and breathing difficulties.
- Crystalline iodine or strong solutions of iodine may cause severe skin irritation.

**Isopropyl alcohol**

- Isopropyl alcohol, used as antiseptic and disinfectant.
- It is used to disinfect thermometers, needles, anesthesia equipment, and other instruments.
- The odor of isopropyl alcohol may be detected at concentrations of 40–200 ppm.
- Exposure to isopropyl alcohol can cause irritation of the eyes and mucous membranes.
- Contact with the liquid may also cause skin rashes.
- Workers should use appropriate protective PPE.
- Splash-proof safety goggles should also be provided and required for use where isopropyl alcohol may contact the eyes.

**Lead (29 CFR 1910.25)**

- Construction and renovation projects can release lead particles into the air.
- Hospital departments of nuclear medicine use lead molds in patient treatment.
- Organizations must confine lead to a specific area.
- Decontamination and shower facilities should be provided to keep lead from being tracked to other areas.
- Workers should use appropriate protective PPE.
- The OSHA standard requires employers to provide initial and annual training to all employees exposed to an airborne concentration.

**Mercury**

- Mercury can be found in some pressure-sensing instruments such as barometers and sensors in mechanical rooms.
- It can also be found in laboratories and some physical plant instruments and switches.

**Methyl methacrylate**

- Methyl methacrylate is used in the fields of medicine and dentistry to make prosthetic devices and as a ceramic filler or cement.
- It is an acrylic cement-like substance used to secure prostheses to bone during orthopedic surgery.
- Exposure usually occurs during mixing, preparation, and in the operating room.
- Symptoms from overexposure can include coughing, chest pain, headache, drowsiness, nausea, anorexia, irritability, and narcosis.
- Dental technicians using bare hands with methyl methacrylate molding putty developed changes in the nerve impulse transmission in the fingers.

- Repeated skin exposures may cause tingling or prickling sensation of the skin.
- Persons with preexisting skin disorders or eye problems, or impaired liver, kidney, or respiratory function may be more susceptible to the effects of the substance.
- OSHA recommends mixing in a closed system, if possible.

### **Peracetic acid**

- Peracetic acid is a powerful sterilant with a sharp, pungent odor.
- At higher concentrations (1%), it can promote tumors in mouse skin.
- Minimize odor and toxicity concerns containing the peracetic acid within the closed machine.
- Peracetic acid is used to sterilize the surfaces of medical instruments and may be found in laboratories, central supply, and patient care units.
- It is a strong skin, eye, and mucous membrane irritant. Currently, no standards exist for regulating exposures to peracetic acid.

### **Pesticides**

- The EPA considers insecticides, herbicides, fungicides, disinfectants, rodenticides, and animal repellents as pesticides.
- OSHA considers pesticides as hazardous substances under the OSHA HCS. EPA regulates pesticides under their FIFRA regulations.
- All pesticides sold in the United States must carry an EPA registration number. Consider these registered substances as safe and effective when used according to directions.
- Pesticides labeled DANGER—POISON indicates highly toxic substances. If inhaled, ingested, or left on the skin, they may be lethal.
- All workers handling, loading, mixing, or applying pesticides fall under the EPA Worker Protection Standards.
- This standard affects all forestry, greenhouse, and nursery workers who perform hand labor in pesticide-treated fields. Some pesticide products require verbal warnings and posted warning signs.

### **Phenol Substances**

- Phenol solutions can prove effective for a wide range of bacteria.
- Some phenolic substances may also be used for intermediate-level disinfection when effective against TB.
- Phenol may be detected by odor at a concentration of about 0.05 ppm.
- Serious health effects may follow exposure to phenol through skin adsorption, inhalation, or ingestion.
- The OSHA PEL for phenol is 5 ppm for an 8 h TWA skin exposure.
- Workers exposed to phenol should wash their hands thoroughly before eating, smoking, or using toilet facilities.

### **Quaternary Ammonium Compounds**

- These substances, widely used as disinfectants, do not work effectively against tuberculosis and gram-negative bacteria.
- Central sterile, environmental services, patient care areas, and clinical services use quaternary compounds for general low-level disinfecting tasks.
- These compounds may cause contact dermatitis and nasal irritation but less irritating to hands than other types of substances.

**Solvents**

- Most solvents remove the natural fats and oils from the skin and may be absorbed.
- Organic solvents pose flammability hazards.
- Safety personnel must properly store solvents in approved safety containers.
- Local exhaust ventilation and enclosure of solvent vapor sources should be used to control laboratory exposures.
- When selecting engineering and other controls, safety personnel must consider both toxicity and flammability risks.
- Toluene and xylene used in laboratories can cause eye and respiratory irritation resulting from exposure to liquid and vapor forms.
- Other exposure symptoms include abdominal pains, nausea, and vomiting, and possible loss of consciousness could occur if ingested in large amounts.
- Toluene must be stored to avoid contact with strong oxidizers such as chlorine, bromine, and fluorine.
- Xylene can also be found in some maintenance departments and clinical labs.

**Ethyl alcohol**

- Many healthcare facilities use 70% ethyl alcohol as a topical application in local skin disinfection.
- Consider ethyl alcohol as flammable in all dilutions where vapor may come in contact with an ignition source.
- The flash point of a 70% solution is approximately 70°F.
- Ethyl alcohol can enhance the drying of the skin.
- Take care when using to avoid dermatitis.
- Make disposal after thoroughly diluting with water and only in an area with adequate ventilation.

**Glutaraldehyde**

- Use glutaraldehyde to disinfect and clean heat-sensitive medical, surgical, and dental equipment.
- Glutaraldehyde solutions serve as a tissue fixative in histology and pathology labs.
- Absorption may occur by inhalation, dermal contact, or ingestion.
- Glutaraldehyde is used to disinfect and clean heat-sensitive equipment such as dialysis instruments, surgical instruments, suction bottles, bronchoscopes, and endoscopes.
- It works well to disinfect ear, nose, and throat instruments.
- The colorless and oily substance gives off a pungent odor.
- Hospital workers use it most often in a diluted form mixed with water or in a commercially prepared product.
- OSHA does not currently publish a PEL for glutaraldehyde.

**3.5 MEDICAL GAS SYSTEMS****P7**

- Bulk medical gas systems involving oxygen and nitrous oxide should meet requirements of the CGA pamphlet “Standard for the Installation of Nitrous Oxide Systems” (No. 8.1) or NFPA 50, Standard for Bulk Oxygen Systems.
- ASSE 6040 Standard Medical Gas Pipeline System Certification requires that all maintenance of medical gas and vacuum systems must be performed by individuals who are qualified under the provisions of ASSE 6040.

- The candidates shall be employed or contracted by a healthcare facility, or actively engaged in working with medical gas systems, and document 1 year of minimum experience in the maintenance of medical gas systems.
- Inspect, test, and maintain critical components of piped medical gas systems, including master signal panels, area alarms, automatic pressure switches, shutoff valves, flexible connectors, and outlets.
- Test piped medical gas and vacuum systems when the systems installed, modified, or repaired, including cross-connection testing, piping purity testing, and pressure testing.
- Maintain the main supply valve and area shut-off valves of piped medical gas and vacuum systems to be accessible and clearly labeled.
- These systems provide oxygen, nitrous oxide, and compressed air throughout the facility.
- When using such systems, heavy and bulky bottles or tanks do not require physical transport throughout a building.
- A plan addressing preventive maintenance and periodic inspection helps ensure that medical gas systems operate safely and reliably.
- As part of an effective management and maintenance plan, inspections and corrective actions should be documented and any faulty fittings should be repaired or replaced immediately.

#### **Other Requirements**

- Doors or gates to enclosures for the gas supply systems will be locked.
- Enclosures for gas supply systems will not be used for storage purposes other than for cylinders containing the nonflammable gases that are to be distributed through the pipeline.
- Storage of empty cylinders disconnected from the supply equipment is permissible.
- Empty cylinders will be segregated and identified.
- Cylinders not in use will be capped and secured in a vertical position by a chain or similar device.
- Cylinders connected to a manifold will also be secured. Plumbing (tubing and so forth) to the manifold will not suffice for this purpose.
- Smoking is prohibited in the gas supply system enclosure. No Smoking signs will be posted.

#### **Anesthetic Gas Hazards**

- Healthcare worker exposures to anesthetic gases can result in the risk of occupational illnesses.
- Healthcare facilities can now better control anesthetic gases through the use and improved design of scavenging systems, installation of more effective general ventilation systems, and increased attention to equipment maintenance and leak detection as well as to careful anesthetic practice.
- Exposure can occur in the operating room, recovery room, or post anesthesia care unit. Some potential health effects of exposure to waste anesthetic gases include nausea, dizziness, headaches, fatigue, irritability, drowsiness, problems with coordination and judgment, as well as sterility, miscarriages, birth defects, cancer, and liver and kidney disease.
- Use appropriate anesthetic gas scavenging systems in operating rooms.
- Never recirculate operating room air containing waste anesthetic gases to the operating room or other hospital locations.

- During the clinical administration of inhaled anesthetics indicate that waste gases can escape into the room air from various components of the anesthesia delivery system.
- Potential leak sources include tank valves; high- and low-pressure machine connections; connections in the breathing circuit, defects in rubber and plastic tubing, hoses, reservoir bags, and ventilator bellows; and the connector.
- In addition, selected anesthesia techniques and improper practices such as leaving gas flow control valves open and vaporizers on after use, spillage of liquid- inhaled anesthetics, and poorly fitting face masks or improperly inflated tracheal tube and laryngeal mask airway cuffs also can contribute to the escape of waste anesthetic gases into the surgical area atmosphere.
- OSHA does not publish exposure limits regulating halogenated agents. NIOSH issues RELs for both nitrous oxide and halogenated agents.

### Scavenging

### P8

- Scavenging is the process of collecting and disposing of waste anesthetic gases and vapors from breathing systems at the site of overflow.
- It is carried out to protect operating room personnel by preventing the dispersal of anesthetic gases into the room air.
- A scavenging system consists of two key components.
- The first is a collecting device or scavenging adapter to collect waste gases, and the second is a disposal route to carry gases from the room.
- This document includes techniques for scavenging, maintaining equipment, monitoring air, and minimizing leakage while administering anesthesia.
- Persons responsible for health and safety in the hospital surgical department should be aware of the availability of new products and new information on familiar products

### Nitric Acid

- Nitric oxide was approved by the FDA for use as a vasodilator in the treatment of hypoxic respiratory failure in full- and near-term infants.
- It is a colorless and essentially odorless gas
- Acute exposure effects include mucous membrane irritation and drowsiness.
- More serious effects include delayed pulmonary toxicity and damage to the central nervous system effects.
- OSHA classifies nitric oxide as a highly hazardous substance.

### Nitrous Oxide

- Nitrous oxide (N<sub>2</sub>O), a clear, colorless, and oxidizing liquefied gas, possesses a slightly sweet odor.
- The product remains stable and inert at room temperature.
- While classified by the DOT as a non- flammable gas, nitrous oxide will support combustion and can deteriorate at temperatures in excess of 1202°F.
- Nitrous oxide is blended with oxygen when used in anesthesia applications.
- The painkilling and numbing qualities of inhaled nitrous oxide begin to take effect at concentrations of 10%.

## 3.6 RESPIRATORY PROTECTION (29 CFR 1910.134)

### P9

- Respirators prevent the inhalation of harmful airborne substances and provide fresh air in oxygen- deficient environments.

- An effective respiratory protection plan must address the following:
  - (1) Hazards encountered
  - (2) Type and degree of protection needed
  - (3) Medical evaluation for respirator usage
  - (4) Selection and fit requirements
  - (5) Training on use and care
  - (6) Methods to ensure continued effectiveness.

### **Types of Respirators**

- Air-purifying respirators come in either full-face or half-mask versions.
- These types of respirators use a mechanical or chemical cartridge to filter dust, mists, fumes, vapors, or gaseous substances.
- Only use disposable air-purifying respirators once or until the cartridge expires.
- These respirators contain permanent cartridges with no replaceable parts.
- Reusable air-purifying respirators use both replaceable cartridges and parts.
- The replaceable cartridges and parts must come from the same manufacturer
- Disposable or reusable air-purifying respirators contain no replaceable parts except cartridges.
- Gas masks designed for slightly higher concentrations of organic vapors, gases, dusts, mists, or fumes use a volume of sorbent much higher than a chemical cartridge.
- Powered air-purifying respirators use a blower to pass the contaminated air through a filter. The purified air then enters into a mask or hood.
- They filter dusts, mists, fumes, vapors, or gases like other air-purifying respirators. Never use air-purifying respirators in any oxygen-deficient atmosphere.
- SAR (supplied-air respirator) provide the highest level of protection against highly toxic and unknown materials.
- Supplied air refers to self-contained breathing apparatuses (SCBAs) and airline respirators.
- Airline respirators contain an air hose connected to a fresh air supply from a central source. The source comes from a compressed air cylinder or air compressor that provides breathable air.
- Emergency Escape Breathing Apparatuses provide oxygen for short periods of times such as 5 or 10 min depending on the unit.
- Determine the correct cartridge for air-purifying respirators by contacting a respirator professional or referring to the SDS of the substance needing filtering.
- Cartridges use a color scheme designating the contaminant needing filtering.
- The proper selection and use of a respirator depends upon an initial determination of the concentration of the hazard or hazards present in the workplace or area with an oxygen-deficient atmosphere.
- Use a full-face piece pressure demand SCBA or a combination full-face piece pressure demand (SAR) for dangerous atmospheres.
- Respirator selection requires matching the respirator with the degree of hazard and needs of the user.
- OSHA requires employers to ensure the medical fitness of individuals that must wear respirators.
- The fitness evaluation considers the physical and psychological stress imposed by the respirator. It must also evaluate the stress originating from job performance.
- Employers must ensure that employees pass the evaluation prior to fit testing or permitting the use of the respirator for the first time.



- A physician or other licensed healthcare professional must determine medical eligibility for respirator wear.
- The OSHA standard requires the fit testing of all tight-fitting respirators.
- OSHA does not exclude disposable particulate respirators from fit-testing requirements.
- Some employees may not achieve an adequate fit with certain respirator models or a particular type of respirator.
- Provide alternative respirator choices to ensure worker protection. Employers must provide a sufficient number of respirator models and sizes from which employees can choose an acceptable respirator with a correct fit.
- Quantitative fit test (QNFT) refers to the assessment of the adequacy of respirator fit by numerically measuring the amount of leakage into the respirator.
- A QNFT uses an instrument to take samples from wearer's breathing zone.
- A qualitative fit test (QLFT) refers to a pass/fail test that assesses the adequacy of respirator fit that relies on the individual's response to a test agent.
- The proper fit, usage, and maintenance of respirators remain the key elements that help ensure employee protection.
- Train employees about the proper use of respirators and the general requirements of the Respiratory Protection Standard.
- Training must address employer obligations such as written plans, respirator selection procedures, respirator use evaluation, and medical evaluations.
- Employers must ensure proper maintenance, storage, and cleaning of all respirators. They must also retain and provide access to specific records as required by OSHA.
- New employees must attend respirator training prior to using a respirator in the workplace.
- Employers must conduct workplace evaluations to ensure that the scope of the written respirator plan protects those required to use respirators.
- Proper evaluations help to determine if workers use and wear respirators correctly.
- The evaluations can also indicate the effectiveness of respirator training.
- Employers must solicit employee views about respirator plan effectiveness and determine any problem areas.
- OSHA requires employers to retain written information regarding medical evaluations, fit testing, and the respirator plan effectiveness.
- Maintaining this information promotes greater employee involvement and provides compliance documentation.
- Employers must retain a record for each employee subject to medical evaluation. This record includes results of the medical questionnaire and, if applicable, a copy of the healthcare professional's written opinion.
- Maintain records related to recommendations including the results of relevant examinations and tests.

**PART-A****1. List out the ways the hazardous materials cause exposures to human?**

- Exposures to hazardous materials can cause stress on the body if inhaled, absorbed, or ingested, concentration, duration of exposure, route of exposure, physical and chemical properties.
- Other chemicals, physical agents, and the general health of the person exposed can influence the effects exerted by a hazardous substance.

**2. What are the ways the reproductive health of humans are damaged?**

- The reproductive health of women or men is damaged due to chemical, physical, or biological hazards.

**3. Give an example of flash points?**

- Consider an ignition source that causes something to burn. Common ignition sources include sparks from tools and equipment; open flames such as torches, smoking materials, and pilot lights, hot particles and hot surfaces such as electric coils.

**4. Define flammable and explosive.**

- Flammable and explosive refers to combustion or the speed at which a material burns. A fire results from a rapid release of energy. An explosion occurs when an instantaneous release of energy involves an extremely rapid rate of combustion.

**5. What is standard used for eye washes and explain?**

- OSHA standard (29 CFR 1910.151) requires employers to provide suitable facilities for quick drenching of the eyes and body for individuals exposed to corrosive materials.
- The manufacturer's operating manual and ANSI Z358.1 for assistance in performing test procedures, maintenance operations, and training.

**6. Define pictogram?**

- This method uses a symbol plus other graphic elements, such as a border, background pattern, or color to convey specific information about the hazards of a chemical.
- Each pictogram consists of a different symbol on a white background within a red square frame set on a point (a red diamond).
- The system requires the use of nine pictograms. However, OSHA requires the use of only eight pictograms under the revised standard.

**7. What is the use of Signal words?**

- This requirement consists of using a signal word to indicate the relative level of the severity of hazard to alert the reader of a potential hazard.
- The signal words used include danger and warning. Use danger for severe hazard and warning for less severe hazards.

**8. What is hazard statement?**

- This requirement consists of a statement assigned to a hazard class and category that describes the nature of the hazards of a chemical. It also includes, as appropriate, the degree of hazard.

**9. Briefly tell about the labelling requirement-Precautionary statement?**

- This phrase describes recommended measures to minimize or prevent adverse effects that could result from exposure to a hazardous chemical.
- It also applies to the improper storage or handling of a hazardous chemical.

**10. In your own opinion, what is data sheet changes?**

- The original standard requires specific information but did not specify a format for presentation or order of information.
- The revised standard requires presenting the information on the SDS using consistent headings in a specified sequence.

**11. Tabulate the uses of OSHA construction asbestos work?**

<b>Class I asbestos work</b> → activities in which thermal system insulation or surfacing material such as sprayed-on fireproofing is removed.
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<b>Class II asbestos work</b> → removal of asbestos-containing wallboard, floor tile and sheeting, roofing and siding shingles, and construction mastics.
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<b>Class III asbestos work</b> → repair and maintenance jobs where ACM (including thermal system insulation or surfacing materials) is likely to be disturbed.
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<b>Class IV asbestos work</b> → maintenance and custodial activities employees should contact ACM or PACM and clean up waste containing ACM and PACM.
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**12. What is the purpose of EPA Asbestos standards?**

- EPA Asbestos-In-Schools Rule (40 CFR Part 763 Subpart E) requires schools to inspect buildings for asbestos and prevent exposure worker/occupant exposure.
- EPA National Emission Standards for Hazardous Air Pollutants (NESHAP 40 CFR 61Subpart M) requires removal of asbestos before demolition removal and waste disposal.

**13. Write short note on Cadmium (29 CFR 1910.1027).**

- Cadmium is a soft, blue and white metal or grayish-white powder commonly used as an anticorrosive for electroplated steel.
- Certain materials and products such as paints, batteries, and phosphate fertilizers also contain cadmium.
- Healthcare safety personnel says the presence of cadmium can occur in lead molds used in radiation medicine.
- Breathing in high levels can cause severe damage to the lungs.
- Short-term effects of exposure include weakness, fever, headaches, chills, sweating, and muscular pain.
- Long-term effects can lead to kidney damage and bone deterioration.

**14. Why Pesticides is define d as danger poison? Give reasons.**

- The EPA considers insecticides, herbicides, fungicides, disinfectants, rodenticides, and animal repellents as pesticides.
- Pesticides labeled DANGER—POISON indicates highly toxic substances. If inhaled, ingested, or left on the skin, they may be lethal.
- All workers handling, loading, mixing, or applying pesticides fall under the EPA Worker Protection Standards.

- This standard affects all forestry, greenhouse, and nursery workers who perform hand labor in pesticide-treated fields. Some pesticide products require verbal warnings and posted warning signs.

**15. Define Scavenging?**

- Scavenging is the process of collecting and disposing of waste anesthetic gases and vapors from breathing systems at the site of overflow.
- It is carried out to protect operating room personnel by preventing the dispersal of anesthetic gases into the room air.

**16. Illustrate about the types of types of scavenging?**

- A scavenging system consists of two key components.
- The first is a collecting device or scavenging adapter to collect waste gases.
- The second is a disposal route to carry gases from the room.
- This document includes techniques for scavenging, maintaining equipment, monitoring air, and minimizing leakage while administering anesthesia.
- Persons responsible for health and safety in the hospital surgical department should be aware of the availability of new products.

**17. Mention about six plans for effective respiratory protection**

- An effective respiratory protection plan must address the following:
  - (1) Hazards encountered
  - (2) Type and degree of protection needed
  - (3) Medical evaluation for respirator usage
  - (4) Selection and fit requirements
  - (5) Training on use and care
  - (6) Methods to ensure continued effectiveness.

**18. What is use of Glutaraldehyde?**

- Glutaraldehyde is used to disinfect and clean heat-sensitive equipment such as dialysis instruments, surgical instruments, suction bottles, bronchoscopes, and endoscopes.
- It works well to disinfect ear, nose, and throat instruments

**19. List out the safety procedures for cylinders maintenance?**

- Storage of empty cylinders disconnected from the supply equipment is permissible.
- Empty cylinders will be segregated and identified.
- Cylinders not in use will be capped and secured in a vertical position by a chain or similar device.
- Cylinders connected to a manifold will also be secured. Plumbing (tubing and so forth) to the manifold will not suffice for this purpose.
- Smoking is prohibited in the gas supply system enclosure. No Smoking signs will be posted.

**20. What are the exposures of anesthetic gas hazards?**

- Exposure can occur in the operating room, recovery room, or post anesthesia care unit. Some potential health effects of exposure to waste anesthetic gases include nausea, dizziness, headaches, fatigue, irritability, drowsiness, problems with

coordination and judgment, as well as sterility, miscarriages, birth defects, cancer, and liver and kidney disease.

- Use appropriate anesthetic gas scavenging systems in operating rooms.

**21. Write a short note on Quaternary Ammonium Compounds?**

- These substances, widely used as disinfectants, do not work effectively against tuberculosis and gram-negative bacteria.
- Central sterile, environmental services, patient care areas, and clinical services use quaternary compounds for general low-level disinfecting tasks.
- These compounds may cause contact dermatitis and nasal irritation but less irritating to hands than other types of substances.

**22. Describe the purpose of Methyl methacrylate?**

- Methyl methacrylate is used in the fields of medicine and dentistry to make prosthetic devices and as a ceramic filler or cement.
- It is an acrylic cement-like substance used to secure prostheses to bone during orthopedic surgery.

**23. What are the hazards or exposures of Methyl methacrylate?**

- Exposure usually occurs during mixing, preparation, and in the operating room.
- Symptoms from over exposure can include coughing, chest pain, headache, drowsiness, nausea, anorexia, irritability, and narcosis.

**24. List any two uses of Ammonia?**

- Ammonia is used as a liquid cleaning agent and as a refrigerant gas.
- Concentrated solutions of ammonia can cause severe burns.

**25. In your opinion tell about the label chart description?**

- A label chart that shows hazard class or division and the associated label plus the section reference can be found in 49 CFR 172.400(b).
- When using two labels, the less hazardous of the two is a secondary hazard. This secondary hazard must contain labeling that meets the requirements of 49 CFR 173.402.

**PART-B**

1. List at least five issues to consider when evaluating hazardous material risks.
2. How does OSHA define a hazardous substance?
3. What does the EPA add to the OSHA definition?
4. How does the DOT define a hazardous substance?
5. Define the following acronyms:
  - a. PEL
  - b. STEL
  - c. REL
  - d. TLV
6. Explain in your own words the purpose of the OSHA Additive Formula found at 29 CFR 1910.1000.
7. List the seven elements required by OSHA in an organization's respirator plan.
8. Describe the following respirators:
  - a. Air-purifying respirator
  - b. Supplied-air respirator
  - c. Self-contained breathing
9. Explain the difference between quantitative fit testing (QNFT) and a qualitative fit testing (QLFT) of a respirator.
10. List at least five physical properties of a chemical substance.
11. Define the following terms:
  - a. Vapor
  - b. Vapor density
  - c. Flash point
  - d. Ignition source
  - e. Grounding
  - f. Bonding
12. What two organizations work to publish consensus eyewash and shower standards?
13. List at least four of the basic requirements for eyewash and shower facilities.
14. What is the foundational consideration when storing hazardous substances?
15. In your own words, explain the impact of GHS requirements on the OSHA HAZCOM standard.
16. List and describe the elements in the new GHS labeling system.
17. List at least five HAZCOM training topics mandated by OSHA.
18. List the nine primary DOT hazard classes.
19. Which federal agency regulates pesticides including registered disinfectants?
20. Define the following EPA terms:
  - a. Ignitable solid waste
  - b. Universal waste
  - c. Medical waste