24-Hr HAZWOPER Module 2

Hazards at the Site

Section 2.1 Overview of Hazardous Substances

2.1.1 Hazardous Materials

Hazardous materials (HAZMATs) are regulated in the United States by several agencies, including the Environmental Protection Agency (EPA), the Occupational Safety and Health Administration (OSHA), the Department of Transportation (DOT), and the Nuclear Regulatory Commission (NRC). The DOT uses the term "hazardous materials" to cover substances classified into nine hazard classes, each with its own subcategories. These classes include explosives, gases, flammable liquids, flammable solids, oxidizing substances, toxic and infectious substances, radioactive materials, corrosives, and miscellaneous hazardous goods. Hazardous substances and hazardous wastes are classified under Class 9 (Miscellaneous Hazardous Goods) by the DOT and regulated by the EPA.

Overall, the definitions and regulations surrounding hazardous materials vary depending on the agency and context. But, all highlight the importance of compliance with relevant guidelines to ensure the safe handling, transport, and disposal of these materials.

2.1.2 Hazardous Waste, Substances, and Chemicals

According to the EPA, a hazardous substance is defined as any chemical that, if released into the environment above a certain threshold, requires reporting. The level of federal involvement in handling such incidents depends on the threat to the environment. The EPA maintains a list of hazardous substances in Title 40, Code of Federal Regulations, Part 302, Table 302.4. OSHA also refers to hazardous substances in the context of emergency response, defining them as substances that may result in adverse effects on the health or safety of employees.

Hazardous waste is a term used by the EPA under the Resource Conservation and Recovery Act (RCRA) to regulate certain chemicals. According to the EPA, solid waste is considered hazardous if it exhibits characteristics of hazardous waste, is listed as hazardous waste in regulations, is a mixture containing both hazardous and non-hazardous waste, or is derived from the treatment, storage, or disposal of listed hazardous waste.

According to OSHA, "chemical substances" refer to chemical elements and their compounds in their natural state or obtained through production processes. This definition includes any additives necessary for product stability and impurities derived from the production process. However, solvents that can be separated without affecting the substance's stability or composition are excluded. Under the Hazard Communication Standard (HCS), a "hazardous chemical" is defined as any chemical classified as a physical hazard, health hazard, simple asphyxiant, combustible dust, pyrophoric gas, or hazard not otherwise classified.

Contrary to common perception, chemicals can exist in various forms, including:

- **Dusts**
- **Fumes**
- **Fibers**
- **Mists**
- **Vapors**
- **Gases**
- **Solids**
- **Liquids**

2.1.3 Examples of Hazardous Chemicals

Hazardous chemicals are commonly found in various facilities and worksites. Here are some common locations and the chemicals found in them:

- **Automotive**: motor oil, fuel, lubricants, and fluids
- **Facility maintenance**: ammonia, chlorine (bleach), sodium hydroxide (drain cleaner), turpentine, paint, and related materials
- **Preservation/renovation**: lead-based paint, acetone, asbestos, glues, paints, and cleaners
- **Pest management**: pesticides, insecticides, fungicides, and herbicides
- **Security**: chemical mace, tear gas, pepper spray, and biohazardous substances

Some types or categories of hazardous chemicals include:
Flammables: Flammables are substances that easily ignite and burn rapidly, including solid flammables like dust and powders, flammable gases, and flammable liquids with specific flash points defined by DOT and EPA regulations.
Combustibles: Combustibles require heating to their flash point temperature before they can ignite.
Oxidizers: Oxidizers supply oxygen chemically or with other oxidizing gases to support fire. They can be in solid, liquid, or gas form, with examples such as chlorine, peroxides, and nitrates.
Corrosives: Corrosives are substances that deteriorate other materials, including metal, body tissue, plastics, and more. They can exist in solid, liquid, or gas form and may cause burns, permanent damage, or dispersal hazards when released into the air. Corrosivity is often determined by a substance's pH value.
Reactives: Reactive hazards refer to substances that can vigorously decompose, condense, or become self-reactive under conditions of shock, pressure, or temperature.
Explosives: Explosives rapidly undergo a chemical transformation, releasing pressure and heat. They can be detonated by shock, heat, or friction, and their volatility varies.

Natural Hazards: While not related to hazardous substance releases, natural hazards can necessitate emergency response. These hazards include events like earthquakes, floods, wildfires, and severe weather conditions.

2.1.4 Routes of Toxicant Entry

Understanding the routes of entry for hazardous chemicals and the types of toxic effects they can cause is crucial in assessing the risks associated with exposure. Here are the four routes of entry:

1. Inhalation: Inhalation is the most common route through which toxic substances enter the body. Fumes, mist, gases, and vapors can easily pass from the lungs into the bloodstream, reaching target organs and tissues.
2. Absorption: Toxic substances can be absorbed through the skin or eyes, making this route of exposure typical. Many substances can permeate healthy skin and enter the bloodstream, potentially causing harm.
3. Ingestion/Oral: Substances can enter the body when consumed through eating, drinking, or smoking. Once in the digestive tract, they can be absorbed through the lining and enter the bloodstream.
4. Injection: Injection is a rapid method of receiving a toxicant, usually occurring through exposure to open wounds. This route bypasses the body's natural barriers and allows for immediate entry of the toxic substance.

The following table summarizes the common symptoms and health issues from various categories of hazardous chemicals.

Table 2.1 Symptoms of Exposure at Work

PART OF BODY	SYMPTOMS	COMMON CAUSES
Head	Dizziness, headache	Solvents, paint, ozone, smoke (including tobacco)
Eyes	Red, watery, irritated, grainy feeling	Smoke, gases, various dusts, vapors from paint and cleaners
Nose and Throat	Sneezing, coughing, sore throat	Smoke, ozone, solvents, various dusts, vapors and fumes from paint and cleaners
Chest and Lungs	Wheezing, coughing, shortness of breath, lung cancer	Metal fumes, various dusts, smoke, solvents, vapors from paint and cleaners
Stomach	Nausea, vomiting, stomachache, diarrhea	Some metal fumes, solvents, paint vapors, long-term lead exposure
Skin	Redness, dryness, rash, itching, skin cancer	Solvents, chromium, nickel, detergents and cleaners, paint on skin
Nervous System	Nervousness, irritability, sleeplessness, tremors, loss of balance or coordination	Long-term solvent exposure, long-term lead exposure
Reproductive System	For men: Low sperm count, damage to sperm	Lead, toluene, some other solvents, ethylene oxide gas

	For women: Irregularities in menstruation, miscarriage, damage to egg or fetus	

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Section 2.2 Hazard Identification and Control

2.2.1 Where are the Hazards?

Understanding the nature of workplace hazards is the first step toward effectively protecting employees. Here are some common hazards present in the workplace:

- Workplaces often involve the presence of hazardous materials, including raw materials used in manufacturing (e.g., wood, metal, plastic), as well as toxic chemicals (e.g., solvents, acids, bases, detergents) utilized at various stages of the process.
- Stationary machinery and equipment may lack proper guarding or be in a state of disrepair due to inadequate preventive or corrective maintenance.
- Tools may not receive proper maintenance, such as the sharpening of saw blades or the replacement of worn-out safety harnesses.
- The work environment may expose employees to extreme noise levels, flammable or combustible atmospheres, or poorly designed workstations. Slippery floors, cluttered aisles, missing or damaged guardrails, ladders, or floor hole covers can also pose hazards.
- Employee factors, such as fatigue, distractions, or lack of mental and physical capacity, can contribute to unsafe conditions.

The list of potential safety hazards in a workplace can be extensive. It is crucial for both workers and supervisors to possess the necessary knowledge and awareness to promptly identify and eliminate workplace hazards. It is important to remember that an accident only occurs when there is both a hazard and exposure to that hazard (Hazard + Exposure = Possible Accident).

2.2.2 Identification and Foreseeability

If you take a moment to observe your surroundings in the workplace, you will likely identify several hazardous conditions or unsafe work practices with relative ease. It's essential to be aware that at any time, an OSHA inspector could initiate a comprehensive inspection upon arriving at your organization's doorstep. What would they discover? What criteria do they use for inspection? Adopting a similar inspection mindset as an inspector would be wise. You can gain insights into the OSHA inspection process by referring to OSHA's Field Operations Manual, Chapter 3.

Once the presence of hazardous substances and health hazards have been determined, it is crucial to identify the risks associated with these substances. Employees working on the site must be informed about the identified hazards, such as:

- Exposures exceeding Permissible Exposure Limits and published exposure levels.
- Concentrations that are Immediately Dangerous to Life or Health.
- Potential sources of skin absorption and irritation.
- Potential sources of eye irritation.
- Explosion sensitivity and flammability ranges.
- Oxygen deficiency.

OSHA standards mandate that employers take feasible and effective measures to eliminate specific hazards from the workplace. Hazards represent the surface causes (conditions) of accidents in the workplace. Additionally, employers must develop robust safety management systems that address the underlying root causes of accidents. For instance, if employees involved in sanding operations are exposed to the hazard of fire caused by sparks in the presence of magnesium dust, management may address this hazard by providing additional training. However, it's crucial to recognize that the hazard is the potential for fire, not the lack of training and supervision. It's important to distinguish between removing surface causes (unique hazards and exposures) and addressing the underlying root causes (failures in the safety management system) that contribute to hazards and exposures. The employer's fundamental obligation is to maintain a hazard- and exposure-free workplace by addressing both the unique surface causes and their underlying root causes.

Understanding "Recognized" Hazards:

Familiarizing yourself with the concept of a "recognized" hazard in the workplace is essential. According to OSHA's Field Compliance Manual, a hazard is recognized if it meets certain criteria, including industry recognition, employer recognition, or a "common sense" recognition standard.

- Industry Recognition: A hazard is recognized if it is acknowledged within the industry. However, recognition by other industries may not be sufficient unless it is proven that the employer's specific branch within the industry recognizes the hazard.
- Employer Recognition: A recognized hazard can be established through evidence of actual employer knowledge, such as written or oral statements made by the employer or instances where employees have alerted the employer to the hazard.
- Common Sense Recognition: If industry or employer recognition cannot be established, recognition can still be valid if it is concluded that any reasonable person would have recognized the hazard. However, it's important to note that "common sense" is

considered a risky concept in safety, and employers should not assume that workplace accidents are solely a result of a lack of common sense.

Understanding Foreseeable Hazards:

Another crucial aspect to consider regarding hazards is foreseeability. Safety managers should address foreseeability during the root cause analysis phase of accident investigations. For OSHA to issue a citation regarding a hazard, it must be reasonably foreseeable. It is not necessary for all factors that could cause a hazard to be present simultaneously in the same location to establish foreseeability. For example:

- If combustible gas and oxygen are present in a confined area but no ignition source is present or expected, there would be no OSHA violation.
- However, if an ignition source is available, and the employer has not taken adequate safety precautions to prevent its use in the confined area, a foreseeable hazard may exist. It is crucial to establish the reasonable foreseeability of the general workplace hazard rather than focusing solely on the hazard that led to a specific accident.

Understanding "Exposure":

To effectively manage workplace safety, it's important to comprehend the concept of "exposure" in relation to hazards. Exposure refers to the condition of being in proximity to a hazard or being subject to its effects. In this course, we will explore three forms of exposure: physical exposure, environmental exposure, and potential exposure.

- **Physical Exposure**: Physical exposure occurs when any part of the body is at risk of injury due to its proximity to a danger zone. For example, if an employee removes a guard and works around moving parts that could cause harm, they are physically exposed to the hazard.
- **Environmental Exposure**: Environmental exposure can affect employees regardless of their distance from the source of the hazard. For instance, if an employee operates a loud saw throughout the day, everyone working near the saw may be exposed to hazardous levels of noise, resulting in environmental exposure.
- **Potential Exposure**: Potential exposure refers to the possibility that an employee could be exposed to a hazardous condition. It encompasses various scenarios, including:
  - When a hazard has previously existed and may recur due to work patterns, circumstances, or anticipated work requirements, making it reasonably predictable that employee exposure could occur.
  - When a hazard poses a danger to employees simply by their presence in the area, and it is reasonably predictable that employees may enter the area during work or for other reasons.

- When a hazard is associated with the use of unsafe machinery or equipment or the presence of hazardous materials, and it is reasonably predictable that employees may use the equipment or be exposed to the hazardous materials during work.

2.2.3 Hazard Categories

To facilitate hazard identification, we can refer to the following 13 hazard categories, adapted from Product Safety Management and Engineering by Willie Hammer:

- **Acceleration**: Fall hazards resulting from sudden changes in speed or motion.
- **Biohazards**: Hazards related to harmful bacteria, viruses, fungi, and molds, often transmitted through the air or blood.
- **Chemical reactions:** Hazards arising from violent chemical reactions, leading to explosions, material dispersion, or heat emissions.
- **Electrical hazards**: Hazards associated with exposure to electrical current, encompassing shock, ignition, heating, unexpected startup, failure to operate, and equipment explosion.
- **Ergonomics**: Hazards resulting from the physical demands of the work, such as lifting, pushing, pulling, and twisting, leading to strains and sprains.
- **Explosives and explosions**: Hazards related to quick releases of gas, heat, noise, light, and overpressure, particularly with high explosives.
- **Flammability and fires**: Hazards related to the presence of fuel, oxidizers, and ignition sources, potentially leading to combustion and accidental fires.
- **Temperature**: Hazards arising from extreme temperatures in the workplace, causing trauma or illness.
- **Mechanical hazards:** Hazards associated with tools, equipment, machinery, and objects containing pinch points, sharp edges, rotating parts, instability, ejected parts, or materials that could cause injury.
- **Pressure**: Hazards arising from increased pressure in hydraulic and pneumatic systems, which may lead to ruptures and injuries.
- **Radiation**: Hazards resulting from exposure to electromagnetic radiation, with different frequencies posing varying degrees of potential injury, from burns to tissue destruction.
- **Toxics:** Hazards related to materials that are considered toxic when they cause harm to the skin and internal organs, entering the body through inhalation, ingestion, absorption, or injection.
- **Vibration/Noise**: Hazards resulting from prolonged exposure to vibration or noise, leading to adverse physiological and psychological effects.

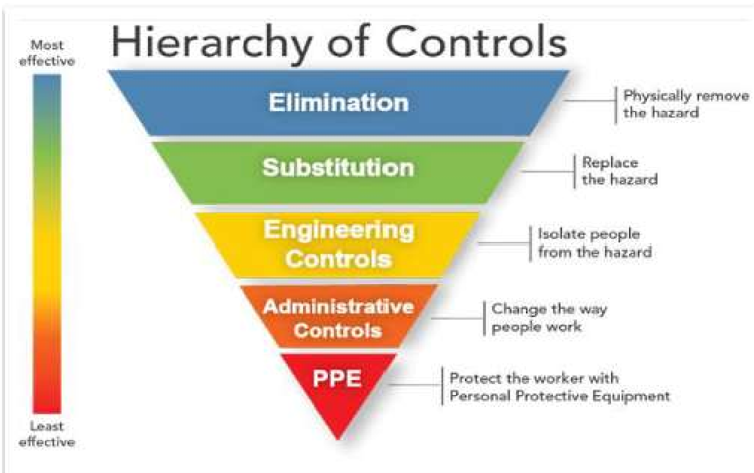
Note that some of these hazards are not related to HAZWOPER and will not be covered in this course.

2.2.4 Hazard Control

Controlling exposures to occupational hazards is essential for safeguarding workers. The hierarchy of controls offers a framework for determining effective and feasible control measures.

One representation of this hierarchy, developed by CDC/NIOSH, is as follows:

Figure 2.1 Controlling the Hazards



This figure emphasizes that control methods higher in the hierarchy are generally more effective and provide greater protection compared to those lower in the hierarchy. Following this approach promotes the implementation of inherently safer systems, significantly reducing the risk of illness or injury.

1. **Elimination**: The best approach is to eliminate hazardous substances altogether. This can be achieved by finding alternatives or greener solutions. For example, replacing toxic cleaners with non-toxic, biodegradable options can significantly reduce chemical hazards. Elimination should be the primary goal to mitigate risks.
2. **Substitution**: If complete elimination is not possible, substituting hazardous substances with less toxic alternatives is the next best strategy. The aim is to select substances that have lower toxicity levels, reducing the need for extensive administrative controls or PPE. In the design or development stage, it may be relatively simple and cost-effective to eliminate or substitute hazards. However, for established processes, substantial changes in equipment and procedures might be necessary.

3. **Engineering Controls:** This strategy focuses on redesigning processes that involve toxic chemicals to eliminate or minimize exposure to the hazardous substance itself. This can be achieved by implementing measures such as total enclosure or ventilation systems. Engineering controls aim to control the hazard at its source or along the path to minimize risk. Well-designed engineering controls provide a high level of worker protection and are independent of worker behavior. Although the initial cost of implementing engineering controls may be higher, they often lead to lower operating costs in the long run and can generate cost savings in other areas of the process.
4. **Administrative Controls:** By changing work procedures, administrative controls aim to reduce the duration, frequency, and severity of exposure to chemical hazards. While this strategy does not eliminate or reduce the hazard itself, it focuses on modifying work practices through written safety policies, rules, supervision, and training. However, it relies heavily on employee compliance and adherence to safe practices.
5. **PPE**: The use of PPE is often a mandatory requirement when working with hazardous chemicals. PPE acts as a physical barrier between the worker and the hazard. However, it is important to note that relying solely on PPE does not eliminate or reduce the hazard itself. Proper training and consistent use of PPE are crucial for this strategy to be effective. While administrative controls and PPE may be relatively inexpensive to establish, they can be costly to sustain over the long term. It's important to note that administrative controls and PPE are generally less effective compared to higher-level control measures. They rely on worker compliance and are unable to fully control all employee behaviors at all times.

By prioritizing control measures based on the hierarchy, organizations can establish safer work environments by systematically addressing hazards and reducing the risk of harm to employees. Any system that relies on human behavior is inherently unreliable.

2.2.5 Exposure Limits

Threshold Limit Values (TLVs) can serve as guidelines for determining the appropriate level of worker protection. Published annually by the American Conference of Governmental Industrial Hygienists, TLVs provide recommended exposure limits and are divided into Time-weighted Average (TWA), Short-Term Exposure Limit (STEL), and Ceiling (C) categories.

Permissible Exposure Limits (PELs) are enforceable standards established by OSHA. In many cases, PELs are derived from TLV values. PELs represent the 8-hour time-weighted average or ceiling concentration above which workers should not be exposed. While PPE may not be required for exposures below the PEL, its use may still be advisable in situations where there is a potential for overexposure. Detailed tables and substance-specific standards can be found in 29 CFR Part 1910, Subpart Z.

Recommended Exposure Limits (RELs) are workplace exposure concentrations recommended by NIOSH for adoption as PELs by OSHA. However, RELs are not enforceable like the OSHA PELs. NIOSH sometimes provides time-weighted average concentrations based on 10-hour averages instead of the usual 8-hour averages.

Immediately Dangerous to Life or Health

Immediately Dangerous to Life or Health (IDLH) concentrations have been established as guidelines for selecting respirators for certain chemicals. The exact definition of IDLH may vary depending on the source, but it generally refers to concentrations that pose an immediate threat to life or health. At hazardous waste sites, IDLH concentrations are considered to be those above which only workers wearing respirators that provide maximum protection, such as positive-pressure, full-facepiece, self-contained breathing apparatus (SCBA), or a combination positive-pressure, full-facepiece, supplied-air respirator with positive-pressure SCBA, are permitted.

Information regarding skin absorption can be found in the ACGIH publication, "Threshold Limit Values for Chemical Substances and Physical Agents," as well as in OSHA standard 29 CFR Part 1910.1000 and other relevant references. These resources identify substances that can be absorbed through the skin, mucous membranes, or eyes either through airborne exposure or direct contact with a liquid. It is important to note that the available information on skin absorption is primarily qualitative and indicates whether a substance may pose a dermal hazard without specifying the extent of absorption. Therefore, decisions regarding skin hazards require judgment based on the available information. Additionally, some chemicals, even if not absorbed through the skin, can still cause skin irritation upon contact. Skin irritation can manifest as redness, swelling, itching, or even burns that damage skin tissue.

Quantitative data on eye irritation may not always be readily available. If literature reviews indicate that a substance causes eye irritation without specifying a threshold, it is recommended to consult a competent health professional to evaluate the available data and determine the level of personal protection required for workers on-site.

2.2.6 Safety Data Sheets

The Safety Data Sheet (SDS) is a critical document that conveys information about chemical hazards from manufacturers to employees. It's essential for training employees on the safe use of hazardous chemicals. Employers are required to have an SDS for each hazardous chemical product used in their operations.

Who Makes the SDS?

Chemical manufacturers and importers must obtain or develop an SDS for each hazardous chemical they produce or import. Employers who mix chemicals that interact may need to create an SDS for the new chemical. If the chemicals do not interact, existing SDSs for each component may suffice. In case of uncertainty about chemical mixing in the workplace, it's advisable to consult with OSHA.

The SDS Form

Let's take a closer look at the SDS form itself. Please click on the following link to view a sample SDS from Lab Alley: https://media.laballey.com/docbuilder/chromium-nitrate-reagent-grade-safety-data-sheet-652b6fd1b00ff.pdf

The chemical manufacturer or importer responsible for preparing the SDS must ensure that it is provided in English, although employers may maintain copies in other languages as well. The SDS has 16 sections. If a subheading within a section has no relevant information, it should state "no applicable information." Let's review each section:

1. **Identification:** Details of the chemical, its uses, and supplier contact information.
2. **Hazards Identification:** Describes hazards and warning information.
3. **Composition/Information on Ingredients:** Lists ingredients, including chemicals, mixtures, and trade secrets.
4. **First Aid Measures:** Offers first aid instructions for exposure.
5. **Fire Fighting Measures:** Provides recommendations for fire response.
6. **Accidental Release Measures:** Guides on spill, leak, or release responses.
7. **Handling and Storage:** Advises on safe handling and storage practices.
8. **Exposure Controls / Personal Protection:** Highlights exposure limits and protective measures.
9. **Physical and Chemical Properties:** Describes physical and chemical characteristics.
10. **Stability and Reactivity:** Provides stability and reactivity information.
11. **Toxicological Information:** Details toxicological and health effects.
12. **Ecological Information (Non-mandatory):** Evaluates environmental impact.
13. **Disposal Consideration (Non-mandatory):** Guides on disposal of waste residues.
14. **Transport Information:** Covers shipping and transportation classifications.
15. **Regulatory Information:** Identifies relevant safety, health, and environmental regulations.

16. **Other Information:** Notes on SDS preparation and revision dates.

Employer Responsibilities with SDS Management

If a hazardous chemical shipment does not include an SDS, it is the employer's responsibility to obtain the SDS from the chemical manufacturer or importer promptly. Employers must maintain copies of the required SDSs for each hazardous chemical used in the workplace.

SDSs must be readily accessible to employees during their work shifts, specifically in their work areas. Employers may use electronic access or other methods to store SDSs, provided they ensure no barriers to immediate employee access. It is crucial that employees are trained and familiar with how to quickly access SDS information, whether stored on computers or online.

For employees working at multiple geographical locations, SDSs can be stored at the primary workplace facility. However, immediate access to this information in emergencies is mandatory.

SDSs may be stored in different forms, including as part of operating procedures. This method is particularly useful for covering groups of hazardous chemicals in a specific work area. Regardless of the storage method, it is essential that all necessary information for each hazardous chemical is provided and readily accessible to employees during each work shift.

Section 2.3 Brownfields and Clandestine Drug Labs

2.3.1 Introduction to Brownfields

A brownfield site refers to a piece of real estate where its potential growth, redevelopment, or reuse might be hindered due to the potential existence of hazardous substances, pollutants, or contaminants.

While brownfields are not inherently contaminated, their past industrial or commercial use does not guarantee that they are free from pollutants.

The possible hazardous substances found on brownfields include:

- Petroleum hydrocarbons
- Gasoline or diesel fuel
- Various metals
- Construction waste that may contain asbestos or lead-based paint
- Polychlorinated biphenyls
- Chemicals used in wood treatment
- A range of industrial chemicals

These contaminants could potentially be found in the air, soil, sediment, surface or groundwater, as well as within structures or containers present at the site.

2.3.2 Introduction to Clandestine Drug Labs

Illicit drug laboratories present a significant threat to both health and the environment due to the toxic chemicals used in the synthesis of methamphetamine, ecstasy, and other synthetic drugs. These chemicals have the potential to pollute buildings, groundwater, soil, and cause harm to people in the vicinity of these labs. One type of clandestine lab is one producing methamphetamine (or meth). Mixing chemicals in clandestine meth labs creates substantial risks of explosions, fires, chemical burns, and toxic fume inhalation. Indications of a structure potentially being used as a meth lab include:

- Propane tanks with fittings that have discolored to blue
- An uncommon quantity of cold medicine containing ephedrine or pseudoephedrine
- Coffee filters that have red staining
- A potent chemical smell, possibly reminiscent of urine
- Glass cookware or frying pans with a powdery residue, bottles connected to rubber tubing, and the presence of other chemicals

Section 2.4 Chemical Hazards in Construction

2.4.1 Exposure to Lead

Employers must assess whether workers on the construction site will be exposed to lead. This determination is typically made through air monitoring, which involves sampling the breath of air workers using specialized equipment. To ensure worker protection, it is important to consider the following two levels of lead exposure:

- **Action Level**: The level at which employers must take action to protect employees. For lead exposure, the action level is an average of 30 micrograms per cubic meter (30 $\mu g/m^3$) of air over an eight-hour period.
- **Permissible Exposure Limit (PEL)**: The legal limit for exposure to lead. Employers must ensure that no employee is exposed to lead concentrations exceeding 50 micrograms per cubic meter (50 $\mu g/m^3$) of air over an eight-hour period.

Trigger Tasks:

Trigger tasks are tasks that involve high levels of lead exposure and require specific interim measures to protect workers. Employers should assume employees are exposed to lead above the PEL if they perform any of these tasks until an initial determination is made. Examples of trigger tasks include cutting with a torch, manual sanding, abrasive blasting, and welding.

If employees perform trigger tasks that potentially expose them to lead, the following protective measures must be implemented until exposure levels are shown to be below the action level:

- Ensure workers wear appropriate respirators.
- Provide adequate protective clothing.
- Establish designated areas for changing and storing clothing, keeping them clean and separate from other areas.
- Ensure workers have access to handwashing facilities.
- Consider providing blood sampling for lead, if necessary.
- Conduct training that covers lead health hazards and appropriate protective measures.

2.4.2 Exposure to Methylene Chloride

Methylene chloride (MC) is a hazardous chemical commonly found in products used by construction companies. Workers may be exposed to MC during activities such as paint stripping, foam application, epoxy paint application, equipment cleaning, and adhesive spraying. High levels of exposure often occur in small, poorly ventilated spaces. MC can enter the body through inhalation, skin absorption, or direct skin contact. OSHA recognizes methylene chloride as a potential occupational carcinogen. Implementing the following engineering controls and work practices can help reduce worker exposure to MC:

- Store and transport MC products in approved safety containers to contain vapors.
- Provide thorough training to employees on hazard awareness, personal hygiene, and the proper use of personal protective equipment.
- Educate employees handling flammable liquids, gases, or toxic materials on safe handling and usage.
- Avoid breathing the air directly above areas covered with MC.
- Minimize direct skin contact with MC by wearing two pairs of gloves: an inner glove made of polyethylene (PE)/ethylene vinyl alcohol (EVOH), PE, or laminate, and an outer glove made of nitrile or neoprene.
- Wear a face shield or goggles to protect the face and eyes.
- Use the washing facilities in the work area to clean off MC from hands and face using soap or mild detergent and water. Do not use MC or other solvents for skin cleaning.
- Develop procedures for containing and cleaning up MC spills or leaks to minimize the chance of accidents.
- Exercise extra caution in low and confined spaces, as MC vapors tend to accumulate in such areas.

2.4.3 Exposure to Chromium

Chromium is a metal extracted from chromite ores, with hexavalent chromium (chromium VI) being a major concern due to its extreme toxicity and classification as a human carcinogen. Many workers are potentially exposed to chromium VI in various industries. Some common industrial sources of hexavalent chromium include chromate pigments, chromates in surface coatings, chrome plating baths, smelting of ferrochromium ore, welding stainless steel, and impurities in Portland cement. Tasks associated with these sources can lead to workplace exposures to hexavalent chromium. Health effects may include lung cancer, respiratory tract irritation or damage, and irritation or damage to the eyes and skin.

To protect employees from the hazards associated with hexavalent chromium, employers should implement the following measures:

- Limit the eight-hour time-weighted average exposure to hexavalent chromium to 5 $\mu g/m^3$.
- Conduct periodic monitoring at least every 6 months if initial monitoring shows exposure at or above the action level (2.5 $\mu g/m^3$ as an 8-hour time-weighted average).
- Provide appropriate PPE to prevent skin or eye contact.
- Establish good personal hygiene and housekeeping practices to minimize hexavalent chromium exposure.
- Prohibit employee rotation as a method to comply with the exposure limit.
- Provide respiratory protection as required by the standard.
- Offer medical examinations to employees within 30 days of initial assignment, annually, and at employment termination, as well as to those exposed in an emergency, those experiencing signs or symptoms of adverse health effects, and those exposed at or above the action level for 30 or more days a year.

2.4.4 Safe Practices

To protect employees from exposure to hazardous chemicals, it is essential to implement the following recommended precautions and safe work practices:

- Maintain a Safety Data Sheet (SDS) for each chemical used in the facility and make it easily accessible to all employees in a language and format that they can clearly understand.
- Adhere to the instructions provided on the SDS for the proper handling of hazardous chemicals.
- Develop and maintain a written Hazard Communication Program that covers SDSs, labeling, and employee training.

- Provide comprehensive training to employees on the requirements of the Hazard Communication Program, including how to read and use SDSs effectively.
- Educate employees about the risks associated with each hazardous chemical they work with.
- Ensure spill clean-up kits are available in areas where chemicals are stored and have a written spill control plan in place.
- Train employees on spill clean-up procedures, including personal protection measures and proper disposal of materials.
- Supply appropriate PPE to employees and enforce its use.
- Store chemicals safely and securely to prevent accidents or unauthorized access.
- Label each container of a hazardous substance with standardized Globally Harmonized System (GHS) labels.

Section 2.5 Bloodborne Pathogens

2.5.1 Understanding Occupational Exposure

Occupational exposure refers to the reasonable anticipation of skin, eye, mucous membrane, or parenteral contact with blood or other potentially infectious materials (OPIM) during an employee's duties. Blood includes human blood, its components, and products derived from human blood. OPIM encompasses various body fluids, unfixed tissue or organ samples, as well as cultures and experimental animal materials infected with bloodborne pathogens.
The primary goal of OSHA's Bloodborne Pathogens Standard is to minimize or eliminate occupational exposure to disease-causing microorganisms found in human blood and body fluids. Key elements include:

- **Annual Training:** All employees with potential occupational exposure must receive annual training to minimize their risk.
- **Primary Pathogens of Concern:** The major bloodborne pathogens are Hepatitis B Virus (HBV), Hepatitis C Virus (HCV), and Human Immunodeficiency Virus (HIV).
- **Exposure Control Strategies:** Employers must develop and enforce comprehensive exposure control strategies for all bloodborne diseases, which includes a formal Exposure Control Plan.

2.5.2 Exposure Control Plan

Employers must establish an Exposure Control Plan (ECP) to eliminate or minimize employee exposure to bloodborne pathogens. The plan should be accessible to all employees, reviewed annually, and updated as needed. The ECP should include information on the following:

- Strategies

- Procedures
- Training
- Communication
- Vaccination
- Post-exposure evaluation
- Recordkeeping
- Sharps injury log

2.5.3 PPE for Bloodborne Pathogens

The purpose of PPE in the context of bloodborne pathogens is to prevent contact between hazardous materials and the skin, eyes, and mouth. Examples of such PPE include disposable gloves, gowns, laboratory coats, shoe covers, protective face shields, goggles, and resuscitation masks. Any equipment that serves to prevent exposure to blood or OPIM is considered PPE for bloodborne pathogens. Note that regular work clothes like uniforms, pants, shirts, or blouses that do not function as protective barriers are not classified as PPE.

2.5.4 Handling Biohazardous Waste and Safe Work Practices

When handling potentially biohazardous waste, it is crucial to ensure safe containment. This involves using specially designed containers that are leak-proof, labeled, or color-coded. The containers should be closed securely before removal to prevent spills. If a container is leaking, it should be placed inside a secondary leak-proof container.

"Contaminated laundry" refers to laundry that is soiled with potential infectious material or contains sharp objects such as needles. When working with contaminated laundry, minimize handling as much as possible. Wear gloves when handling it and place it in labeled, leak-proof bags or containers before transportation. It is important not to take contaminated protective clothing home for laundering, even if it is personal clothing.

When picking up potentially contaminated broken glassware, use mechanical means such as tongs, forceps, or a brush and dustpan.

Routinely clean and decontaminate all equipment and work surfaces that could potentially become contaminated, using appropriate disinfectants while wearing PPE.

Additionally, reusable receptacles like pails and bins should be decontaminated regularly and promptly when visible contamination is observed.

Section 2.6 Atmospheric Hazards in Confined Spaces

Many accidents in confined spaces occur because workers are unaware of the dangers or potential hazards present in or near the space. Often, workers may not consider the new hazards and conditions that can arise during work in confined spaces. Therefore, it is crucial to thoroughly identify all confined space hazards and understand how they can impact the health and safety of workers entering the space before entering such spaces.

Confined space hazards can be broadly categorized into two primary categories:

1. **Atmospheric Hazards:** These hazards pertain to issues with the air within the space, such as oxygen deficiency, the presence of harmful gases, or the accumulation of combustible dust. This will be the focus of this section.
2. **Non-Atmospheric Hazards:** These hazards encompass physical risks and other conditions resulting from equipment, electrical contact, materials, temperature extremes, and hazardous surfaces.

A hazardous atmosphere refers to any atmosphere that can incapacitate, injure, impair self-rescue, or cause acute illness or death to workers and rescuers entering confined spaces. Examples of hazardous atmospheres within confined spaces include:

- Oxygen concentrations below 19.5% (oxygen deficiency) or above 23.5% (oxygen enrichment) at sea level.
- Flammable or explosive gases, vapors, or mists exceeding 10% of their lower flammable or explosive limits.
- Combustible dust suspended in the air, obscuring vision within five feet or less.
- Atmospheric concentration of substances with acutely toxic effects exceeding their Permissible Exposure Limits.
- Any other atmospheric condition immediately dangerous to life or health (IDLH).

Atmospheric concentrations of substances incapable of causing death, incapacitation, impairment, injury, or acute illness are not included in hazardous atmospheres.

For guidance on acceptable atmospheric conditions, consult reputable sources such as:

- Safety Data Sheets (SDSs)
- OSHA Permissible Exposure Limits - Annotated Tables
- National Institute for Occupational Safety and Health (NIOSH) Pocket Guide to Chemical Hazards

2.6.1 Oxygen Deficiency

The normal atmosphere contains approximately 20.9% oxygen, 78.1% nitrogen, 1% argon, and trace amounts of other gases.

Oxygen deficiency can lead to asphyxiation. While maintaining the atmospheric oxygen level above 19.5% by volume is ideal, the body can tolerate slight deviations from this norm.

The effects of oxygen deficiency at various levels include:

- Greater than 16%: deterioration of night vision (noticeable only when normal oxygen concentration is restored), increased breathing volume, and accelerated heartbeat.
- Between 14-16%: increased breathing volume, accelerated heartbeat, poor muscular coordination, rapid fatigue, and intermittent respiration.
- Between 10-14%, faulty judgement, intermittent respiration, and exhaustion.
- Between 6-10%: nausea, vomiting, inability to perform tasks, and unconsciousness.
- Less than 6%: spasmodic breathing, convulsive movements, and death within minutes.

Reduction in oxygen levels within confined spaces can occur through either consumption or displacement.

Oxygen consumption: Oxygen is consumed by people, during combustion processes (e.g., welding, cutting, and heating), and by bacterial activity (e.g., fermentation). Rust formation on exposed surfaces can also consume oxygen. The number of people working in a confined space and their physical activity level can influence oxygen consumption rates.

Oxygen displacement: Oxygen deficiency can occur when other gases displace air. Helium, argon, nitrogen, and carbon dioxide are examples of gases used to displace air, thereby reducing oxygen levels. Carbon dioxide, naturally present in sewers, storage bins, wells, tunnels, wine vats, and grain elevators, can also displace air. Total displacement of oxygen by nitrogen can lead to immediate collapse and death. Carbon dioxide and argon, with higher specific gravities than air, can persist in tanks or manholes for extended periods after opening. Since these gases are colorless and odorless, they pose immediate health hazards unless oxygen measurements and proper ventilation are carried out.

2.6.2 Oxygen Enrichment

Oxygen enrichment occurs when the air contains more than 23.5 percent oxygen. This condition poses a severe fire hazard as static electricity from materials like hair or clothing can ignite a fire. Additionally, any fire in an oxygen-enriched environment will burn more readily. Oxygen enrichment is not a natural occurrence and should be thoroughly investigated. To ensure safety, confined spaces should always be ventilated with normal, ambient air, and the use of pure oxygen should be avoided.

2.6.3 Combustible and Flammable Atmospheres

Atmospheres containing combustible dust, flammable gases, or vapors present a significant danger due to the potential for fire or explosion. The "fire triangle" describes the three essential elements necessary for an atmosphere to become flammable: an ignition source (heat or flame), fuel (combustible gas or vapor), and oxygen. Two additional factors contribute to the risk of an explosion:

- **Dispersion**: Describes how the dust, gas, or vapor may be dispersed throughout the confined space. The potential for an explosion may exist in certain areas while being unlikely in others. Adequate forced air ventilation is crucial to prevent hazardous levels of dispersion.
- **Confinement**: Keeps the dust, gas, or vapor from being adequately dispersed. Ensuring proper air ventilation is vital to avoid hazardous levels of confinement.

However, for a mixture to be readily ignitable, the proportions of fuel and oxygen must fall within the flammable range, described below.

Lower Explosive Limit and Lower Flammable Limit

The Lower Explosive Limit (LEL) is the minimum concentration of fuel in a fuel-air mixture at which a gas or vapor can explode, while the Lower Flammable Limit (LFL) is the lowest concentration at which the gas or vapor will burn. Fuel concentrations below the LEL/LFL are considered too "lean" and will not explode or burn due to insufficient fuel in the mixture. Flammability limits are not absolute and depend on the type and strength of the ignition source.

Upper Explosive Limit and Upper Flammable Limit

The Upper Explosive Limit (UEL) is the maximum atmospheric concentration of a gas or vapor in a fuel-air mixture that can explode, while the Upper Flammability Limit (UFL) is the highest fuel concentration above which the mixture will not burn. Above the UEL/UFL, the mixture is considered too "rich" and will not explode or burn due to an excess of fuel. The composition of a fuel vapor and air mixture can change over time and may fluctuate within a confined space due to movement and disturbances.

Flammability Range

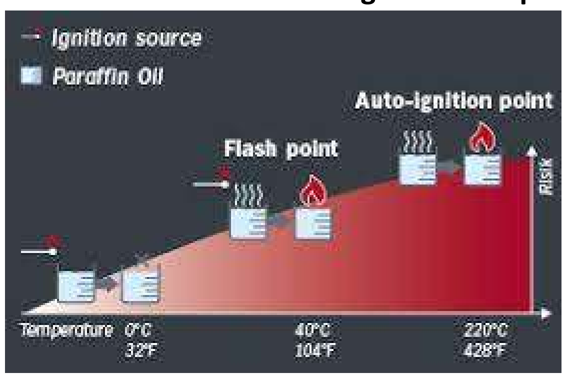
Gases or vapors can only be explosive or flammable within their LEL/LFL and UEL/UFL range, known as the explosive/flammable range. Substances with a wide explosive/flammable range are more hazardous than those with a narrow range. However, any concentration of combustible gas or vapor should be taken seriously in a confined space. When ventilating a space containing a gas or vapor above its UEL/UFL, workers should exercise caution. Ventilation should reduce the concentration below the LEL/LFL to mitigate the risk of an explosion or fire.

The flash point of a substance refers to the minimum temperature at which it releases enough vapor to form an ignitable mixture with the air just above its surface. It's important to note that ignition at the flash point is not continuous.

On the other hand, the Ignition Temperature, or Auto-Ignition Temperature, is the minimum temperature required to initiate self-sustained combustion without an external ignition source. When assessing the fire and explosion potential at a hazardous waste site, all equipment should be intrinsically safe or explosion-proof.

Asecos's diagram below further illustrates the flash point and Auto-Ignition Temperature.

Figure 2.2 Flash Point and Auto-Ignition Temperature



* from aseco.com

In the presence of flammable or explosive atmospheres, ventilation can help dilute the mixture below the LEL or LFL. However, if concentrations exceed the UEL or UFL, ventilation is generally not recommended as it would pass through the flammable/explosive range during dilution. It's worth noting that combustible gas indicator readings may not be accurate when oxygen concentrations are below 19.5 percent.

Combustible Dust

Finely powdered dust from combustible materials, such as wood, metal, or grain, can serve as fuel for powerful explosions. Dust clouds can form when handling dusty materials or during processes like grinding, drilling, or crushing that produce smaller particles. Airborne combustible dust at an explosive concentration can obscure vision within a five-foot range. Actual dust concentrations can be measured using direct reading instruments

2.6.4 Toxic Gases

Confined spaces can contain toxic gases for various reasons, including the processes being performed within the space, migration of gases and vapors from adjacent areas, and the release of vapors from previously contained chemicals on surfaces. Toxic gases can pose serious health risks and may lead to asphyxiation, carcinogenic effects, or other systemic toxic effects. Common toxic gases encountered in confined spaces include hydrogen sulfide (H_2S), carbon monoxide (CO), methane (CH_4), and solvents.

2.6.5 Irritant/Corrosive Atmospheres

Irritant gases can be found in various industrial sectors and can be categorized as primary irritants (no systemic toxic effects) or secondary irritants (may produce systemic toxic effects). Examples of irritant gases include chlorine, ozone, hydrochloric acid, hydrofluoric acid, sulfuric acid, nitrogen dioxide, and ammonia. Prolonged exposure to irritant or corrosive concentrations in confined spaces can weaken defense reflexes and increase the risk of toxic substance exposure.

2.6.6 Testing for Hazardous Atmospheres

Atmospheric testing is essential for evaluating the hazards of a permit space and verifying the presence of acceptable entry conditions. The testing sequence follows the OFT acronym: Oxygen, Flammable or explosive atmospheres, and Toxic atmospheres. Oxygen levels should be between 19.5% and 23.5%, flammability limits should be below 10% of the LFL, and readings for toxic atmospheres should be below recognized exposure limits.

Continuous monitoring is necessary to detect the development of hazardous atmospheres during entry into confined spaces. Our senses may not detect certain contaminants at low concentrations, and reliance on odor alone can be misleading. The atmosphere in a confined space should be analyzed using sensitive and specific equipment to identify and evaluate hazardous atmospheres. Electronic gas detectors and color-indicator gas detector tubes are commonly used instruments. Testing should be done by a qualified person based on evaluation of all serious hazards, and residual concentrations of contaminants should be within acceptable entry conditions. Sampling should be conducted at regular intervals and results recorded on the permit. If entrants leave the space and re-enter, the atmosphere should be tested again as it can change rapidly. Test results must be available to the entry team or representatives, even if employees are using respirators.

Section 2.7 Heat and Cold Stress

2.7.1 Factors Contributing to Heat Stress

Wearing PPE puts hazardous waste workers at a higher risk of developing heat stress, which can lead to various health issues and even serious illness or death. Regular monitoring and preventive measures are crucial due to the common occurrence and potential severity of heat stress at hazardous waste sites.

The amount and type of PPE worn directly affects work tolerance and the risk of excessive heat stress. PPE adds weight and bulk, limits the body's natural heat exchange mechanisms (such as evaporation, convection, and radiation), and increases energy expenditure. When selecting PPE, careful evaluation of each item's benefits and its potential to increase the risk of heat stress is necessary. The safe duration of work/rest periods should be determined based on factors such as the anticipated work rate, ambient temperature, environmental conditions, type of protective ensemble, and individual worker characteristics and fitness.

2.7.2 Monitoring for Heat Stress

Heat stress incidence depends on various factors, so monitoring is important for all workers, including those not wearing protective equipment. For workers wearing permeable clothing, the monitoring requirements and suggested work/rest schedules in the current American Conference of Governmental Industrial Hygienists' (ACGIH) Threshold Limit Values for Heat Stress should be followed. However, for workers wearing semi-permeable or impermeable encapsulating ensembles, the ACGIH standard cannot be applied. In these cases, monitoring should be conducted when the temperature in the work area exceeds 70°F (21°C). The initial frequency of heat stress monitoring depends on the air temperature adjusted for solar radiation and the level of physical work. The length of the work cycle should be determined based on the required frequency of physiological monitoring. The following table suggests how often you should conduct heat stress monitoring.

Table 2.2 Suggested Frequency for Heat Stress Monitoring

Adjusted Temperature	**For workers with normal work clothes, conduct monitoring…**	**For workers wearing impermeable protective clothing, conduct monitoring…**
90°F (32.2°C) or above	After each 45 minutes of work	After each 15 minutes of work
87.5° - 90°F (30.8° - 32.2°C)	After each 60 minutes of work	After each 30 minutes of work
82.5° - 87.5°F (28.1° - 30.8°C)	After each 90 minutes of work	After each 60 minutes of work
77.5° - 82.5°F (25.3 - 28.1°C)	After each 120 minutes of work	After each 90 minutes of work
72.5° - 77.5°F (22.5° - 25.3°C)	After each 150 minutes of work	After each 120 minutes of work

Heart Rate:

Measure the radial pulse for 30 seconds at the beginning of the rest period. If the heart rate exceeds 110 beats per minute, shorten the next work cycle by one-third while keeping the rest period the same. If the heart rate still exceeds 110 beats per minute at the next rest period, shorten the following work cycle by one-third.

Oral Temperature:

Measure the oral temperature at the end of the work period using a clinical thermometer or similar device (3 minutes under the tongue). If the oral temperature exceeds 99.6°F (37.6°C), shorten the next work cycle by one-third without changing the rest period. If the oral temperature still exceeds 99.6°F (37.6°C) at the beginning of the next rest period, shorten the following work cycle by one-third. Workers should not wear semi-permeable or impermeable garments if their oral temperature exceeds 100.6°F (38.1°C).

Body Water Loss:
Measure weight at the beginning and end of each workday on an accurate scale (±0.25 lb.). This helps determine if enough fluids are being consumed to prevent dehydration. Weight measurements should be taken with the worker wearing similar clothing or ideally while nude. The body water loss should not exceed 1.5 percent of total body weight loss in a workday.

Common symptoms of heat stress include heat rash, heat cramps, heat exhaustion, and heat stroke.

2.7.3 Prevention of Heat Stress

To prevent heat stress, management should take the following steps:

- Adjust work-rest schedules and mandate work slowdowns as needed.
- Rotate personnel and job functions to minimize overstress or overexertion at one task.
- Add additional personnel to work teams.
- Perform work during cooler hours of the day if possible or at night with adequate lighting.
- Provide shelter or shaded areas for rest periods, preferably air-conditioned if available.
- Encourage workers to maintain optimal physical fitness and acclimatize to site conditions.
- Provide cooling devices to aid in body heat exchange (field showers, hose-down areas, cooling jackets or suits).
- Train workers to recognize and treat heat stress.

To help maintain body fluids at normal levels, daily fluid intake should approximate the amount of water lost in sweat. Management should:

- Encourage workers to drink more water when heavy sweating occurs.
- Maintain water temperature at 50° to 60 °F (10° to 15.6°C).
- Provide small disposable cups for easy and frequent hydration.
- Urge workers to drink fluids before starting work and at regular intervals during work.
- Weigh workers before and after work to assess fluid replacement adequacy.

2.7.4 Signs and Symptoms of Cold Stress

Two common types of cold injuries and their signs and symptoms include:

- Hypothermia: Shivering, slurred speech, confusion, drowsiness, slow heartbeat, weak pulse.
- Frostbite or frostnip: Numbness, tingling, white or grayish-yellow skin, waxy appearance.

Prompt recognition and appropriate action should be taken when these signs and symptoms occur to prevent serious injury.

2.7.5 Prevention of Cold Stress

To prevent cold stress and related injuries, considerations must be given to both the individual and the environment, as follows:

- Avoid exposure to humidity and high winds.
- Minimize contact with wetness or metal.
- Wear adequate and appropriate clothing layers to retain body heat and allow sweat evaporation.
- Protect the feet, hands, head, and face as they are the most susceptible to cold.
- Wear several layers of clothing for better insulation and adjust layers as needed.
- Use windproof and waterproof outer layers.
- Monitor for early signs and symptoms of cold stress.

Environmental controls, acclimatization, adequate fluid intake, salt replacement, medical screening, proper work clothing, and training contribute to prevention. Environmental controls involve engineering controls, work practices, work-rest schedules, environmental monitoring, and wind chill temperature considerations. Acclimatization can be achieved to some extent in cold environments, but certain individuals may have difficulty acclimatizing. Staying hydrated is crucial to prevent dehydration caused by significant water loss in cold areas. Maintaining a balanced diet is generally sufficient for salt intake, and consulting a physician is recommended for those with high blood pressure or on restricted sodium diets. Wind chill factors should be taken into account, as air temperature alone does not accurately assess the cold hazard. Proper clothing, access to warm shelter, well-scheduled work and rest periods, and monitoring workers' physical condition are essential preventive measures. Alcohol should never be used to keep warm as it increases the risk of cold exposure.

Section 2.8 Asbestos

2.8.1 Exposure to Asbestos

Asbestos is a hazardous material commonly found in construction materials. Asbestos refers to a group of naturally occurring fibrous minerals known for their high tensile strength, flexibility, and resistance to heat, chemicals, and electricity. It is widely recognized as a health hazard, and its use is strictly regulated by OSHA and the EPA. Asbestos fibers, which pose health risks, are too small to be seen with the naked eye.

Exposure to asbestos is commonly associated with the following health issues:

- **Asbestosis**: A condition characterized by the scarring of lungs with fibrous tissue, leading to breathing difficulties and often requiring oxygen assistance.
- **Cancer**: Lung cancer is the most prevalent form of cancer associated with asbestos exposure. Other areas of the body, such as the throat, gastrointestinal tract, and kidneys, can also develop cancer due to asbestos exposure.
- **Mesothelioma**: A rare and often fatal cancer that typically occurs in the chest cavity.

Construction workers may encounter asbestos during various activities, including:

- Demolition or salvage work involving structures containing asbestos.
- Removal or encapsulation of asbestos-containing materials.
- Construction, alteration, repair, maintenance, or renovation of structures or substrates containing asbestos.
- Installation of products containing asbestos.
- Clean-up of asbestos spills or emergencies.
- Transportation, disposal, storage, containment, and housekeeping activities involving asbestos or asbestos-containing products.

Asbestos Work Classification:
OSHA has established a classification system for asbestos-related construction work, outlining mandatory and technological work practices that employers must follow to reduce worker exposure. The classification system consists of four classes with decreasing control requirements as follows:

Class I: This class represents the most hazardous asbestos-related jobs. It involves the removal of asbestos-containing thermal system insulation and sprayed-on or troweled-on surfacing materials.

Class II: This class covers the removal of other types of asbestos-containing materials, excluding thermal system insulation. Examples include resilient flooring, roofing materials, ceiling tiles, siding, and transit panels.

Class III: This class includes repair and maintenance operations that disturb asbestos-containing material (ACM) or presumed asbestos-containing material (PACM).

Class IV: This class pertains to custodial activities in which employees clean up asbestos-containing waste and debris resulting from construction, maintenance, or repair activities. It involves tasks such as cleaning dust-contaminated surfaces, vacuuming contaminated carpets, mopping floors, and removing ACM or PACM from thermal system insulation or surfacing material.

Regulated Areas:
All Class I, II, and III asbestos work must be conducted within regulated areas. The following requirements apply to regulated areas:

- **Restricted Access**: Only authorized personnel are permitted to enter regulated areas. Access to these areas is limited to individuals with proper training and authorization.
- **Competent Supervision**: A designated competent person must supervise all asbestos work carried out within the regulated area. This person ensures compliance with safety protocols and oversees the proper execution of asbestos-related tasks.
- **Area Marking**: The regulated area must be clearly marked to minimize the number of individuals within the area and protect those outside from airborne asbestos exposure. Critical barriers or negative-pressure enclosures can be used to demarcate the regulated area effectively.
- **Visible Warning Signs**: Prominently displayed warning signs must be posted in and around the regulated area. These signs should be easily readable and comprehensible, conveying the necessary information related to asbestos hazards. The signs may include symbols or text indicating the presence of asbestos and associated safety precautions.
- **Respirator Provision**: Employers must provide each person entering regulated areas with appropriate respirators. Respiratory protection is essential to prevent inhalation of asbestos fibers and minimize the risk of respiratory health issues.
- **Prohibited Activities**: In regulated areas, employees are prohibited from engaging in activities that could introduce additional risks. This includes refraining from eating, drinking, smoking, chewing tobacco or gum, or applying cosmetics, as these actions could potentially lead to asbestos ingestion or exposure.
- **Communication with Other Employers**: The employer responsible for work within a regulated area must inform other employers on the site about the nature of the asbestos-related work being conducted, the requirements specific to regulated areas, and the measures implemented to ensure the protection of on-site employees. Effective communication among employers helps maintain a safe working environment for everyone involved.

Control Measures:

To comply with Permissible Exposure Limits (PELs) and Short-Term Exposure Limits (STELs), the following control methods should be implemented for all covered work:

- **Local Exhaust Ventilation**: Install local exhaust ventilation systems with HEPA filter dust collection to effectively capture and remove asbestos dust at its source.
- **Enclosure and Isolation**: Enclose or isolate processes that generate asbestos dust to prevent its dispersion into the surrounding environment. This containment helps minimize the potential for employee exposure.
- **Ventilation**: Maintain proper ventilation in regulated areas to ensure the movement of contaminated air away from employees' breathing zones. Use ventilation systems that direct the air towards filtration or collection devices equipped with HEPA filters to effectively remove asbestos particles.
- **Engineering Controls and Work Practices**: Implement engineering controls and work practices to reduce asbestos exposure to the lowest feasible levels. This may include process modifications, physical barriers, and work procedures that minimize the release and spread of asbestos fibers. Respirators should be used in conjunction with these controls to achieve compliance with PELs or STELs, or even lower levels if possible.
- **Notification and Waste Management**: File a notification with the appropriate regulatory agency (e.g., DEQ/LRAPA) to ensure compliance with reporting requirements. Use designated waste shipment forms for the safe transport of asbestos-containing waste materials.

Additionally, the following engineering controls and work practices should be applied to all work operations, regardless of exposure levels:

- **Vacuum Cleaning**: Utilize vacuum cleaners equipped with HEPA filters to effectively collect and contain all asbestos-containing or presumed asbestos-containing debris and dust.
- **Wet Methods**: Implement wet methods or use wetting agents to control employee exposures during asbestos-related activities. Wetting the materials helps to suppress the release of asbestos fibers. However, it's important to exercise caution when wetting methods pose electrical hazards, equipment malfunctions, slipping hazards, or other risks.
- **Electrical Safety**: Deactivate electrical circuits if they are not equipped with ground-fault circuit interrupters (GFCI) to minimize electrical hazards during asbestos work.

- **Prompt Cleanup and Disposal**: Ensure the prompt and proper cleanup of asbestos-contaminated waste and debris. Dispose of these materials in leak-tight containers to prevent further contamination and potential exposure.

Prohibited Work Practices and Engineering Controls:
To ensure safety during asbestos-related work or any activities that involve the disturbance of asbestos or presumed asbestos-containing materials, adhere to the following prohibited work practices and engineering control measures, irrespective of measured exposure levels or initial assessments:

- **High-Speed Abrasive Disc Saws**: Avoid using high-speed abrasive disc saws unless they are equipped with a point-of-cut ventilator or enclosed with exhaust air equipped with HEPA filters. These control measures help contain and capture asbestos particles generated during cutting operations.
- **Compressed Air Usage**: Refrain from using compressed air for the removal of asbestos or asbestos-containing materials unless it is used in conjunction with an enclosed ventilation system. This prevents the dispersal of asbestos fibers into the surrounding environment.
- **Dry Cleanup Methods**: Prohibit the use of dry sweeping, shoveling, or any other dry cleanup techniques for dust and debris associated with asbestos. These practices can lead to the release of airborne asbestos fibers and increase the risk of exposure. Instead, use wet methods or vacuum cleaners with HEPA filters for proper cleanup.
- **Employee Rotation**: Avoid rotating employees as a means to reduce asbestos exposure. Instead, implement appropriate engineering controls, work practices, and personal protective equipment to ensure the safety of all workers involved.
- **Accumulation of Friable Asbestos**: Prevent the accumulation of friable asbestos materials or asbestos-containing waste. Promptly remove and dispose of these materials in accordance with proper procedures to minimize the risk of exposure.
- **Proper Disposal:** Ensure that asbestos materials and waste are disposed of at authorized sites in compliance with applicable regulations. Improper disposal can lead to environmental contamination and potential exposure to asbestos fibers.