40-Hour HAZWOPER

Student Manual

16th Edition

NES
ENVIRONMENTAL HEALTH & SAFETY
SOLUTIONS

40-Hour HAZWOPER
Student Manual 16th Edition
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SECTION I: FEDERAL REGULATIONS

A. OSHA & OSH ACT

The Occupational Safety and Health Administration (OSHA) was established under the Occupational Safety and Health Act (OSH Act) in 1970. The goal of OSHA was to ensure employers provide workers a place of employment free from safety and health concerns. The main objectives of OSHA are:

- Development of criteria
- Establishment of standards
- Recordkeeping
- Enforcement of programs

General Duty Clause

According to Title 29, section 654 of the Code of Federal Regulations (29 CFR 654), each employer must:

- Furnish to each employee employment and a place of employment free from recognized hazards that are causing or are likely to cause death or serious physical harm
- Comply with associated occupational safety and health standards

Further, each employee must comply with occupational safety and health standards and all associated rules, regulations, and orders.

Training Requirements

All employees, supervisors, and management personnel responsible for the site must receive training meeting the requirements of 29 CFR 1910.120 before they are permitted to engage in hazardous waste operations that could expose them to safety or health hazards.

NIOSH

In order to establish standards for workplace health and safety, the OSHA Act also created the National Institute for Occupational Safety and Health (NIOSH). Though established by the same act, the two agencies have separate responsibilities. The main objectives for NIOSH are to:

- Conduct research to reduce worker illness and injury and advance worker well-being
- Promote safe and healthy workers through interventions, recommendations, and capacity building
- Enhance worker safety and health through global collaboration

B. HAZWOPER 29 CFR 1910.120

The Hazardous Waste Operations and Emergency Response (HAZWOPER) standard was established in 1989 by OSHA in response to major chemical releases into the environment throughout the U.S. (notable incidents include the Love Canal Disaster in New York and the Valley of the Drums in Kentucky). These events affected human health, environmental health, and properties.

It is specified in the HAZWOPER standard that all hazardous waste workers and those who would be performing emergency response activities are required to complete training before engaging in hazardous waste operations. Training must include:

- Use of personal protective equipment (PPE)
- Emergency response for emergencies
- Practices that minimize risks from hazards
- Safety, health, and other hazards present on-site

C. U.S. EPA 40 CFR

U.S. EPA (United States Environmental Protection Agency) was established on December 2, 1970 to consolidate in one agency a variety of federal research, monitoring, standard-setting, and enforcement activities to ensure environmental protection. Since its inception, U.S. EPA has been working for a cleaner, healthier environment for the American people.

Regulatory Citations

- Solid Waste Regulation: 40 CFR 239-259
- RCRA, CERCLA, SARA (hazardous waste regulations): 40 CFR 260-279
- Underground Storage Tanks: 40 CFR 280
- FIFRA: 40 CFR 150-189
- Clean Water Act: 40 CFR 402
- Clean Air Act: 40 CFR 50-97

U.S. EPA Hazardous Waste Definition

Hazardous waste is waste with properties that make it dangerous or capable of having a harmful effect on human health or the environment. U.S. EPA categorizes hazardous waste as either characteristic or listed waste.

Characteristic waste is based on the chemical's characteristics:

- Ignitable: D001
  - » Flash point of less than 140°F
  - » Oxidizers, flammable solids/gases
- Corrosive: D002
  - » Aqueous material pH of ≤ 2 (acid) and ≥ 12.5 (base)
- Reactive: D003
  - » Unstable, violently water-reactive, capable of detonation, explosive
- Toxic: D004-D043
  - » As determined by U.S. EPA's Toxicity Characteristic Leaching Procedure (TCLP)

Listed wastes are wastes that are listed as hazardous under RCRA but that have not been subjected to the TCLP because the dangers they present are considered self-evident. Listed wastes are either F, K, P, or U.

D. CLEAN WATER ACT

The Clean Water Act (CWA) establishes the basic structure for regulating discharges of pollutants into the waters of the United States and for regulating quality standards for surface waters. The Federal Water Pollution Control Act, the basis of CWA, was enacted in 1948, and the act was significantly reorganized and expanded in 1972, during which time "Clean Water Act" became the act's common name (with amendments).

CWA requires anyone who wants to discharge pollutants to first obtain a National Pollutant Discharge Elimination System (NPDES) permit. Otherwise, the discharge will be considered illegal.

E. CLEAN AIR ACT

Congress established much of the basic structure of the Clean Air Act in 1970 and made major revisions to it in 1977 and 1990. Dense, visible smog in many of the nation's cities and industrial centers helped to prompt passage of the 1970 legislation at the height of the national environmental movement. The subsequent revisions were designed to improve its effectiveness and to target newly recognized air pollution problems such as acid rain and damage to the stratospheric ozone layer.

F. RESOURCE CONSERVATION AND RECOVERY ACT (RCRA)

The Resource Conservation and Recovery Act (RCRA) of 1976, which amended the Solid Waste Disposal Act, was the first substantial effort by Congress to establish a regulatory structure for the management of solid and hazardous wastes. Subtitle C of RCRA addresses lifetime tracking ("cradle to grave") requirements for hazardous waste from the point of initial generation to ultimate disposal. Subtitle D of RCRA contains less restrictive requirements for non-hazardous solid waste. The Hazardous and Solid Waste Amendments (HSWA) of 1984 established additional waste management requirements and added Subtitle I, which imposes management requirements for underground storage tanks (USTs) that contain petroleum or hazardous substances. Most RCRA requirements are not industry-specific; rather, they apply to any company that transports, treats, stores, or disposes of hazardous waste.

The main objectives of RCRA are to:

- Protect human health and the environment from the hazards posed by waste disposal
- Conserve energy and natural resources through waste recycling and recovery
- Reduce or eliminate, as expeditiously as possible, the amount of waste generated, including hazardous waste
- Ensure wastes are managed in a manner that is protective of humans and the environment

G. COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION, AND LIABILITY ACT (CERCLA)

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA),

commonly known as the "Superfund" Act, was enacted by Congress on December 11, 1980. This law created a tax on the chemical and petroleum industries and provided broad federal authority to respond directly to releases or threatened releases of hazardous substances that may endanger public health or the environment. Over five years, $1.6 billion from the tax was collected in a trust fund dedicated to cleaning up abandoned or uncontrolled hazardous waste sites. CERCLA:

- Established prohibitions and requirements concerning closed and abandoned hazardous waste sites
- Provided for liability of persons responsible for releases of hazardous waste at these sites
- Established a trust fund to provide for cleanup when no responsible party could be identified
- Enabled the revision of the National Contingency Plan (NCP), which provides the guidelines and procedures needed to respond to releases and threatened releases of hazardous substances, pollutants, or contaminants

The NCP established U.S. EPA's National Priorities List (NPL). CERCLA authorizes two kinds of response actions:

- Short-term removals, where actions may be taken to address releases or threatened releases requiring prompt response
- Long-term remedial response actions that permanently and significantly reduce the dangers associated with releases or threats of releases of hazardous substances that are serious but not immediately life-threatening (only at sites listed on the NPL)

H. SUPERFUND AMENDMENTS AND REAUTHORIZATION ACT (SARA)

The Superfund Amendments and Reauthorization Act (SARA) reflected U.S. EPA's experience in administering the complex Superfund program during its first six years and made several important changes and additions to the program. SARA:

- Stressed the importance of permanent remedies and innovative treatment technologies in cleaning up hazardous waste sites
- Required Superfund actions to consider the standards and requirements found in other state and federal environmental laws and regulations
- Provided new enforcement authorities and settlement tools
- Increased state involvement in the Superfund program
- Increased focus on human health problems posed by hazardous waste sites
- Encouraged citizen participation in making decisions on how sites should be cleaned up
- Increased size of the trust fund to $8.5 billion

SARA also required U.S. EPA to revise the Hazard Ranking System (HRS) to ensure it accurately assessed the degree of risk to human health and the environment posed by uncontrolled hazardous waste sites that may be placed on the NPL.

I. EMERGENCY PLANNING AND COMMUNITY RIGHT-TO-KNOW ACT (EPCRA)

Updates to SARA resulted in the creation of the Emergency Planning and Community Right-to-Know Act (EPCRA), also known as SARA Title III. EPCRA requirements are as follows:

- Emergency planning notification
- Emergency release notification
- Hazardous chemical inventory reporting
- Toxics release inventory reporting

J. FEDERAL INSECTICIDE, FUNGICIDE, AND RODENTICIDE ACT (FIFRA)

The primary focus of the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) was to provide federal control of pesticide distribution, sale, and use. U.S. EPA was given authority under FIFRA not only to study the consequences of pesticide usage but also to require users (farmers, utility companies, and others) to register when purchasing pesticides.

Through later amendments to the law, users also must take exams for certification as applicators

of pesticides. All pesticides used in the U.S. must be registered (licensed) by U.S. EPA. Registration assures that pesticides will be properly labeled and, if in accordance with specifications, will not cause unreasonable harm to the environment.

K. TOXIC SUBSTANCES CONTROL ACT (TSCA)

The Toxic Substances Control Act (TSCA) of 1976 provided U.S. EPA the authority to establish reporting, recordkeeping, and testing requirements and restrictions relating to chemical substances. TSCA addresses the production, importation, use, and disposal of specific chemicals, including polychlorinated biphenyls (PCBs), asbestos, radon, and lead-based paint.

L. DEPARTMENT OF TRANSPORTATION (DOT)

The Department of Transportation (DOT) was established on October 15, 1966 by Congress. DOT develops policies to ensure a safe and efficient transportation system. Regulations for safe hazardous materials transport are found in 49 CFR.

A **hazmat employer** is a business/person who utilizes one or more employees to transport, or cause to transport, hazardous materials in commerce, or represents, marks, certifies, sells, offers, reconditions, tests, repairs, or modifies containers, drums, or packaging for use in transporting hazardous materials.

A **hazmat employee** is one who directly affects the safe transportation of hazardous materials, either as a self-employed person or one who performs duties relating to hazardous materials as part of the job.

M. HAZARDOUS MATERIALS TRANSPORTATION UNIFORM SAFETY ACT (HMT-USA)

In 1990 Congress enacted the Hazardous Materials Transportation Uniform Safety Act (HMT-USA) to clarify the often conflicting state, local, and federal regulations. HMT-USA requires the Secretary of Transportation to promulgate regulations for the safe transport of hazardous materials in intrastate, interstate, and foreign commerce. The Secretary of Transportation also retains the authority to designate materials as hazardous when they pose unreasonable risks to health, safety, or property. The statute includes provisions to encourage uniformity among different state and local highway routing regulations, develop criteria for the issuance of federal permits to motor carriers of hazardous materials, and regulate the transport of radioactive materials.

See table below for DOT packaging specifications.

CHARACTER	DESCRIPTION		
TYPE OF PACKAGE	1 – Drums	3 – Jerrycans	5 – Bags
	2 – Barrels	4 – Boxes	6 – Composite packagings
MATERIAL	A – Steel	F – Reconstituted wood	M – Paper, multiwall
	B – Aluminum	G – Fiberboard	N – Metal other than steel/aluminum
	C – Natural wood	H – Plastic	P – Glass, porcelain, or stoneware
	D – Plywood	L – Textile	
CATEGORY	1 – Closed head	2 – Open head	
PACKING GROUP	X – Packing Groups I, II & III	Z – Packing Group III only	
	Y – Packing Groups II & III		
DENSITY / SPECIFIC GRAVITY	Solids or packagings that have inner packagings marked with the weight in kilograms		
	Packagings containing liquids marked with specific gravity rounded down to the first decimal		
SOLIDS / INNER PACKAGING	Upper-case "S" should follow the density		
	Liquids reflect the hydrostatic test pressure in kPa, rounded down to the nearest 10 kPa		
YEAR OF MANUFACTURE	Last two digits of data indicate the year the packaging was manufactured		
MANUFACTURE LOCATION	Country where the item was manufactured		
MANUFACTURER CODE	Code for UN certifying agency or manufacturer		

SECTION II: CALIFORNIA HAZWOPER REGULATIONS

California's version of the HAZWOPER standard is found in 8 CCR 5192.

The purpose of the HAZWOPER standard is to protect the health and safety of those who work with hazardous waste by requiring their employers to develop and implement workplace health and safety programs.

While its primary focus is to protect workers at abandoned hazardous waste sites, the HAZWOPER standard also has special provisions for the on-site treatment, storage, and disposal of hazardous waste at facilities with RCRA licenses from U.S. EPA.

8 CCR 5192 Overview

a. Scope, application, and definitions

b. Safety and health program

c. Site characterization and analysis

d. Site control

e. Training

f. Medical surveillance

g. Engineering controls, work practices, and personal protective equipment for employee protection

h. Monitoring

i. Informational programs

j. Handling drums and containers

k. Decontamination

l. Emergency response by employees at uncontrolled hazardous waste sites

m. Illumination

n. Sanitation at temporary workplaces

o. New technology programs

p. Certain operations conducted under the Resource Conservation and Recovery Act of 1976

q. Emergency response to hazardous substance releases

Appendix A: Personal Protective Equipment (PPE) Test Methods

Appendix B: General Description and Discussion of the Levels of Protection and Protective Gear

Appendix C: Compliance Guidelines

Appendix D: References

A. SCOPE & DEFINITIONS (a)

Hazardous Waste Site Workers

- At federal or state superfund sites
- At hazardous waste sites designated for cleanup by other government agencies, including during the initial site investigation stage
- At sites where the company or "responsible party" is voluntarily cleaning up a site recognized by a government agency as an uncontrolled hazardous waste site
- At RCRA-permitted sites with waste areas in need of "corrective action"

Treatment, Storage, and Disposal Facility Workers

- Workers at RCRA-permitted treatment, storage, and disposal facilities (TSDFs)

Emergency Response Workers

- Anyone involved in on-site or off-site emergency response activities

How the standard applies to your facility will vary depending on whether you are an emergency responder and, if so, what the level of response is at which you are involved.

Definitions (a)(3)

Clean-up Operation: An operation where hazardous substances are removed, contained, incinerated, neutralized, stabilized, cleared-up, or in any other manner processed or handled with the ultimate goal of making the site safer for people or the environment.

Decontamination: The removal of hazardous substances from employees and their equipment to the extent necessary to preclude the occurrence of foreseeable adverse health effects.

Hazardous Substance: Any substance which

results or may result in adverse effects on the health or safety of employees.

Hazardous Waste Operation: Any operation conducted within the scope of this regulation including hazardous substance removal work.

Hazardous Waste Site: Any facility or location at which hazardous waste operations within the scope of this regulation take place.

Incidental Release: An incidental release is one that does not cause a health or safety hazard to employees and does not need to be cleaned up immediately to prevent death or serious injury to employees.

Uncontrolled Release: An uncontrolled release is the accidental release of a hazardous substance from its container. If not contained, stopped, and removed, the release would pose a hazard to the employees in the immediate area or in areas in the path of the release.

Uncontrolled Hazardous Waste Site: An area where an accumulation of hazardous waste creates a threat to the health and safety of individuals, the environment, or both. Some sites are found on public lands, such as those created by former municipal, county, or state landfills where illegal or poorly managed waste disposal has taken place. Other sites are found on private property, often belonging to generators or former generators of hazardous waste.

B. SAFETY & HEALTH PROGRAM (b)

Employers of employees involved in hazardous waste operations must develop and implement a written safety and health program. The program must be designed to identify, evaluate, and control safety and health hazards, and provide for emergency response for hazardous waste operations. The written safety and health program must incorporate the following:

- An organization structure
- A comprehensive workplan
- A site-specific Safety and Health Plan
- The safety and health training program
- The medical surveillance program
- The employer's standard operating procedures for safety and health
- Any necessary interface between general program and site-specific activities

The site Safety and Health Plan, at a minimum, must address:

- Safety and health risks or hazard analysis for each site task/operation
- Employee training assignments
- Personal protective equipment (PPE) to be used
- Medical surveillance
- Air/personnel monitoring and environmental sampling methods
- Site control measures
- Decontamination procedures
- An Emergency Response Plan
- Confined space entry procedures
- A spill containment program

C. SITE CHARACTERIZATION & ANALYSIS (c)

All hazardous waste sites need to be evaluated to determine the appropriate safety and health controls that need to be implemented to protect employees from the identified hazards. This includes:

- Preliminary evaluation
  - » Performed off-site to gather as much information as possible to aid in the selection of employee protection
- Hazard identification
  - » An identification of all hazards needs to be performed during the preliminary evaluation
- Required information
  - » All aspects of the response need to be outlined to the greatest extent possible prior to the employees entering the site
- Personal protective equipment
  - » All PPE must be provided to the employees and must be based on the preliminary evaluation utilizing the highest level of protection necessary to reduce employee

exposure below the permissible exposure limits (PELs) and other published exposure limits

- Monitoring
  - » Must be performed before any entry into the site begins
- Risk identification
  - » Employees who will be working on the site must be informed of any risks associated with hazardous substances and health hazards that have been identified
- Employee notification
  - » Any information concerning the chemical, physical, and toxicological properties of each substance known or expected to be present on-site prior to the commencement of work activities

D. SITE CONTROL (d)

Appropriate site control procedures must be implemented to control employee exposure to hazardous substances before cleanup work begins. A site control program for protecting employees is part of the employer's site safety and health program. It is developed during the planning stages of a hazardous waste cleanup operation and modified as necessary as new information becomes available.

E. TRAINING (e)

All employees working on-site who are exposed to hazardous substances, health hazards, or safety hazards and their supervisors and management personnel responsible for the site must receive training before they are permitted to engage in hazardous waste operations.

Training must cover:

- Names of personnel and alternates responsible for site safety and health
- Safety and health hazards present at the site
- Use of PPE
- Safe work practices
- Safe use of engineering controls and equipment
- Medical surveillance

Training Requirements

General Site Worker

- 40 hours of general training
- 3 days of supervised field training
- 8 hours of refresher training annually

Occasional Site Worker

- 24 hours of general training
- 1 day of supervised field training
- 8 hours of refresher training annually

Regular On-site Worker

- 24 hours of general training
- 1 day of supervised field training
- 8 hours of refresher training annually

Management & Supervisor

- At a minimum, must complete same level of training as subordinates
- 8 hours of specialized hazardous waste operations management training at the time of assignment
- 8 hours of refresher training annually

F. MEDICAL SURVEILLANCE (f)

Medical screening and medical surveillance are two strategies for optimizing employee health. The fundamental purpose of medical screening is early diagnosis and treatment of the individual. The fundamental purpose of medical surveillance is to detect and eliminate the underlying causes, such as hazards or exposures to any discovered trends.

Medical Surveillance Program: B.E.A.T.

Within the Health and Safety Plan, employers need to include a Medical Surveillance Program. Medical exams are to be conducted:

- Prior to assignment: "**B**aseline"
- At the development of signs and symptoms of "**E**xposure"
- Once every 12 months: "**A**nnually"
  - » Not to exceed two years

- At "**T**ermination" of employment
- If a physician determines it is medically necessary

G. ENGINEERING CONTROLS, WORK PRACTICES & PPE FOR EMPLOYEE PROTECTION (g)

Engineering controls, work practices, personal protective equipment (PPE), or a combination of these must be implemented in order to properly protect employees from exposure to hazardous substances and safety and health hazards.

Engineering controls and work practices are instituted to reduce and maintain employee exposure to a level at or below PELs. Whenever engineering controls and work practices are not feasible or are not required, PPE is to be used to meet this requirement.

A written PPE program is required as part of the employer's safety and health program. The PPE program must include:

- PPE selection based upon site hazards
- PPE use and limitations of the equipment
- Work mission duration
- PPE maintenance and storage
- PPE decontamination and disposal
- PPE training and proper fitting
- PPE donning and doffing procedures
- PPE inspection procedures
- Effectiveness evaluation of the program
- Limitations during extreme conditions

H. MONITORING (h)

Monitoring is performed where there may be the potential for worker exposure to hazardous substances. It is also used to identify and quantify airborne levels of hazardous substances and health and safety hazards to determine proper levels of PPE.

Initial entry air monitoring is conducted to identify dangerous atmospheres or conditions before work is conducted. Periodic monitoring is conducted whenever the possibility that a dangerous atmosphere or condition has developed.

I. INFORMATIONAL PROGRAMS (i)

Informational programs must be developed to inform all affected employees about the nature, level, and degree of exposures that are likely to occur at the site.

J. HANDLING DRUMS & CONTAINERS (j)

When handling drums and containers, all protective measures must be in place before work begins. If drum contents are unknown, always consider the highest hazard, and follow all regulations when handling drums of any size.

K. DECONTAMINATION (k)

Decontamination procedures need to be established and implemented before any equipment or employee enters a hazardous workplace. Decontamination must follow a standard operating procedure established for the specific site and be based on the chemicals that are found at that site.

L. EMERGENCY RESPONSE BY EMPLOYEES AT UNCONTROLLED HAZARDOUS WASTE SITES (l)

An Emergency Response Plan (ERP) must be established and implemented by all employers to handle any anticipated emergencies.

Employers who will evacuate their employees from the danger area when an emergency occurs without assisting are exempt from the ERP requirement as long as the employer provides an Emergency Action Plan that is compliant with 8 CCR 3220.

M. ILLUMINATION (m)

Illumination is required while working at hazardous waste sites. A table is included in the regulation text that can be used as a reference for the minimum illumination intensities of foot-candles.

N. SANITATION AT TEMPORARY WORKPLACES (n)

Sites must have an adequate supply of potable water. Non-potable water needs to be properly identified. An appropriate number of toilet facilities need to be provided for the amount of personnel on-site. Showers and changing rooms are based on the site conditions and must be provided if the hazardous waste removal operation will last six months or longer.

O. NEW TECHNOLOGY PROGRAMS (o)

New technologies must be developed and implemented for improving protection of employees and must be included as part of the Site Safety Plan. New technologies, equipment, or control measures available to the industry must be evaluated by the employer to determine effectiveness.

P. CERTAIN OPERATIONS AT TSD FACILITIES PERMITTED UNDER RCRA (p)

Employers conducting operations at treatment, storage, and disposal facilities (TSDFs) must provide and implement the following programs:

- Safety and Health Program
  - » Must be written and designed to identify, evaluate, and control safety and health hazards in the facility
- Hazard Communication Program
  - » Cal/OSHA, 8 CCR 5194
- Medical Surveillance Program
- Decontamination procedures
- New Technology Program
- Material Handling Program
  - » Covers the handling of drums and containers
- Training Program
  - » To enable employees to perform duties in a safe and healthful manner so as not to endanger themselves or other employees
- Emergency Response Plan
  - » Must be rehearsed, reviewed, and updated and all emergency personnel trained
  - » An employee alarm system is mandatory
- Material Handling Program

Q. EMERGENCY RESPONSE TO HAZARDOUS SUBSTANCE RELEASES (q)

Emergency Response Plans (ERP) are required on-site to manage any release or potential release of hazardous substances and will outline the proper chain of command during such a release. An ERP must address all of the following:

- Pre-emergency planning
- Personnel roles, authority, and communication
- Emergency recognition and prevention
- Safe distances and places of refuge
- Site security and control
- Evacuation routes and procedures
- Decontamination procedures that are not covered by the site Safety and Health Plan
- Emergency medical treatment and first aid
- Emergency alerting and response procedures
- Critique of response and follow-up
- PPE and emergency equipment

Emergency Response Training Levels

Workers who respond to emergencies at TSDFs and fixed facilities must be trained. The amount of training depends on the duties an individual is required to perform. There are five levels of training.

1. First responder awareness (FRA)
   - Likely to witness or discover a hazardous substance release and initiate the emergency response sequences
2. First responder operations (FRO)
   - Responds in a defensive fashion to contain the release from a safe distance and to prevent exposures
   - Receives 8 hours of training and demonstrates

competency

3. Hazardous materials technician

- Responds to a release or potential release of a hazardous substance for the purpose of stopping it
- Minimum of 24 hours of training, of which 8 hours must be at the first responder operations level

4. Hazardous materials specialist

- Responds with and provides support to hazardous materials technicians
- Minimum of 24 hours training to the technician level, with additional competencies

5. On-scene incident commander

- Will assume control of the incident scene beyond the first responder awareness level
- Minimum of 24 hours training, with additional competencies

R. APPENDICES TO THE REGULATIONS

- Appendix A – Personal Protective Equipment Test Methods
- Appendix B – General Description and Discussion of the Levels of Protection and Protective Gear
- Appendix C – Compliance Guidelines
- Appendix D – References

S. OTHER REQUIREMENTS

- 3203 – Injury and Illness Prevention Program (IIPP)
- 3220 – Emergency Action Plan
- 5144 – Respiratory Protection
- 5155 – Airborne Contaminants
- 5156-58 – Confined Space
- 5193 – Bloodborne Pathogens
- 5194 – Hazard Communications
- 1512 – First Aid and CPR

SECTION III: CHEMICAL HAZARDS

Under specific circumstances, a substance's chemical hazard(s) may pose a more immediate and/or serious hazard to an individual than do its toxic properties. The ability to identify chemical hazard properties of substances is the basis for determining safe handling and chemical exposure prevention procedures for individual materials. Categorizing chemical materials by their chemical hazards (hazard categorization) organizes and simplifies field handling and reduces the likelihood of chemical injury or exposure.

CAUTION: Do not assume that chemicals will react in the same manner based on similar chemical name or physical state.

A **chemical property** may be observed by changing how the substance behaves with other substances. Some examples of chemical properties are:

- Reactivity
- Flammability
- Oxidation

A **physical property** is an aspect of matter that can be observed or measured without changing the material. Some examples of physical properties are:

- Odor
- Molecular weight
- Volume

A. DEFINITIONS

Auto Ignition Temperature: Temperature at which ignition occurs without a source of ignition, expressed in mm/Hg.

Boiling Point: The temperature at which a liquid changes to a gas or vapor.

Corrosiveness: The ability of a substance to cause corrosion (destruction of metals and biological tissue).

Density: Weight per unit volume.

Flammable/Explosive Range: The concentration range of gas/vapor (fuel) that will burn or explode if an ignition source is introduced.

Flash Point: The minimum temperature at which a liquid gives off vapor within a test vessel in sufficient concentration to form an ignitable mixture with air near the surface of the liquid.

Freezing Point: The temperature at which a liquid changes to a solid.

Incompatibility: How substances adversely interact with other materials.

Melting Point: The temperature at which a solid changes to a liquid.

Separation: Establishing or providing a physical barrier (or distance) between segregated hazardous chemicals.

Segregation: Placing chemicals into distinct groups (i.e., categories) based on their hazardous properties.

Solubility: The ability of a substance to dissolve.

Specific Gravity: Ratio of the density of a substance to the density of water.

WATER = 1 < 1 = FLOATS > 1 = SINKS

Sublimation: Temperature at which a solid changes to a gas.

Vapor Density: Ratio of the density of a gas or vapor to the density of ambient air.

AIR = 1 < 1 = RISES > 1 = SETTLES

Vapor Pressure: The pressure exerted by a chemical vapor in air at a given temperature and pressure.

B. DOT HAZARD CLASSES

The Department of Transportation mandates that certain vehicles that transport hazardous materials are labeled and placarded according to the regulations. DOT identifies 9 hazard classes, each with their own special properties. Some of these hazard classes are further broken down into divisions. DOT uses placards and labels to help easily identify the hazards associated with these materials.

Class 1: Explosive	Class 6: Poisonous
Class 2: Gaseous	Class 7: Radioactive
Class 3: Flammable liquids	Class 8: Corrosive
Class 4: Flammable solids	Class 9: Miscellaneous
Class 5: Oxidizers	

DOT/UN HAZARD CLASSES (HMT-USA)	
Class 1: Explosive Materials	
	Division 1.1 consists of explosives that have a mass explosion hazard. A mass explosion is one that affects almost the entire load instantaneously.
	Division 1.2 consists of explosives that have a projection hazard but not a mass explosion hazard.
	Division 1.3 consists of explosives that have a fire hazard and either a minor blast hazard or a minor projection hazard, or both, but not a mass explosion hazard.
	Division 1.4 consists of explosive devices that present a minor explosion hazard. No device in this division may contain more than 25 g (0.9 oz) of a detonating material.
	Division 1.5 consists of very insensitive explosives. This division comprises substances that have a mass explosion hazard but that are so insensitive that there is very little probability of initiation or of transition from burning to detonation under normal conditions or transport.
	Division 1.6 consists of extremely insensitive articles that do not have a mass explosive hazard. This division comprises articles that contain only extremely insensitive detonating substances and that demonstrate a negligible probability of accidental initiation or propagation.
Class 2: Gaseous Materials	
	Division 2.1 (Flammable Gas) consists of any material that is a gas at 20°C (68°F) or less and 101.3 kPa (14.7 psia) of pressure that: • Is ignitable when in a mixture of 13 percent or less by volume with air; OR • Has a flammable range with air of at least 12 percent, regardless of the lower limit
	Division 2.2 (Non-Flammable, Non-Poisonous Compressed Gas) includes compressed gas, liquefied gas, pressurized cryogenic gas, and compressed gas in solution. This division comprises any material or mixture that: • Exerts in the packaging an absolute pressure of 200 kPa (43.8 psia) or greater at 20°C (68°F) • Does not meet the definition of Division 2.1 or Division 2.3
	Division 2.3 (Gas Poisonous by Inhalation) materials are gases at 20°C (68°F) or less and 101.3 kPa (14.7 psia) of pressure and are poisonous by inhalation. These are known to be so toxic to humans as to pose a hazard to health during transportation or, in the absence of adequate data on human toxicity, are presumed to be toxic to humans because, when tested on laboratory animals, the materials had an LC_{50} value not more than 5,000 mL/m^3.
Class 3: Flammable Liquid Materials	
	A **flammable liquid** is any liquid having a flash point of not more than 60°C (140°F). • Exceptions: Materials meeting the definition of any Class 2 material or a mixture having one or more components with a flash point greater than 60.5°C (141°F) or higher that makes up at least 99 percent of the total volume of the mixture or a distilled spirit of 140 proof or lower is considered to have a flash point of lower than 23°C (72°F) A **combustible liquid** is any liquid that does not meet the definition of any other hazard class and has a flash point above 60°C (140°F) and below 93°C (200°F).

DOT/UN HAZARD CLASSES (HMT-USA)	
Class 4: Flammable Solid Materials	
	Division 4.1 (Flammable Solid) includes any flammable solid material of the following three types: • Wetted explosives that, when dry, are explosive Class 1 other than those of compatibility group A, which, when wetted, suppress the explosive properties and materials specifically authorized by name in 49 CFR 171.101 or by the Associate Administrator for Hazardous Materials • Self-reactive materials that are liable to undergo, at normal or elevated temperatures, a strongly exothermal decomposition caused by excessively high transport temperatures or by contamination • Readily combustible solids that may cause a fire through friction, show a burning rate faster than 2.2 mm (0.087 inches) per second under specified test procedures or any metal powder that can be ignited and will react over the whole length of a sample in 10 minutes or less under specified test procedures
	Division 4.2 (Spontaneously Combustible) material includes any pyrophoric material, liquid or solid, that even in small quantities and without an external ignition source can ignite within five minutes after coming in contact with air under specified test procedures. A self-heating material that, when in contact with air and without an energy supply, is liable to self-heat and that exhibits spontaneous ignition under specified test procedures would be classed as a Division 4.2 material.
	Division 4.3 (Dangerous When Wet) material is one that, by contact with water, is liable to become spontaneously flammable or gives off flammable or toxic gas at a rate greater than 1 liter per kilogram of material per hour under specified test procedures.
Class 5: Oxidizers	
	Division 5.1 (Oxidizing) material means a material that may, generally by yielding oxygen, cause or enhance the combustion of other materials.
	Division 5.2 (Organic Peroxide) material is an organic compound containing oxygen in the bivalent -O-O- structure and that may be considered a derivative of hydrogen peroxide where one or more of the hydrogen atoms have been replaced by organic radicals (with some exceptions).
Class 6: Poisonous Materials	
	Division 6.1 (Poisonous) materials are those materials, other than gases, that are known to be so toxic to humans as to present a hazard to health during transportation or, in the absence of adequate data on human toxicity, are presumed to be toxic to humans when they fall within the specified oral, dermal, or inhalation toxicity ranges when tested on laboratory animals or are an irritating material, with properties similar to tear gas, that cause extreme irritation, especially in confined spaces.
 	Division 6.2 (Infectious Substance) materials are infectious substances. An infectious substance is a viable microorganism or its toxin that causes or may cause disease in humans or animals, including those agents listed in 42 CFR 72.3 (*infectious substances* and *etiologic agents* are synonymous). **Diagnostic specimens** means any human or animal material including but not limited to excreta, secreta, blood and its components, tissue, and tissue fluids shipped for purposes of diagnosis or biological product prepared and manufactured in accordance with the provisions of 9 CFR parts 102 to 104 and 21 CFR parts 312 and 600 to 680 and that, in accordance with these provisions, may be shipped in interstate commerce.

DOT/UN HAZARD CLASSES (HMT-USA)	
Class 7: Radioactive Materials	
	Radioactive material means any material having a specific activity greater than 0.002 microcuries per gram.
Class 8: Corrosive Materials	
	A **corrosive material** is a liquid or solid that causes visible destruction or irreversible alteration in human skin tissue at the site of contact or a liquid that has a severe corrosion rate on steel or aluminum in accordance with specified criteria.
Class 9: Miscellaneous Materials	
	A **miscellaneous hazardous material** is a material that presents a hazard during transport but that is not included in any other hazard class. Class 9 includes any material that has an anesthetic, noxious, or other similar property that could cause extreme annoyance or discomfort to a flight crew member so as to prevent the correct performance of assigned duties and any material that is not included in any other hazard class but is subject to regulatory requirements because it meets the definition in 49 CFR 171.8 for a hazardous substance or a hazardous waste.

C. CHEMICAL INCOMPATIBILITY

Under specific circumstances, a substance's incompatible chemicals will react upon contact. Incompatibility does not necessarily indicate a serious hazard, but many mixtures of incompatible chemicals will react violently. The ability to identify incompatible chemicals is the basis for establishing proper chemical handling procedures.

Reaction of two or more incompatible chemicals (including with water or air) may cause any of the following:

- Generation of heat
- Fire
- Explosion
- Toxic gas
- Formation of shock- or friction-sensitive compounds
- Solubilization of toxic substances
- Formation of a toxic byproduct

CAUTION: Chemicals in the same general hazard category may be incompatible. Examples are flammable and oxidizing compressed gases and hydrochloric and sulfuric acids.

SECTION IV: TOXICOLOGY

Toxicology is the study of adverse health effects caused by exposure to chemical substances and the resultant interaction with the human body. How a person may be exposed to a chemical plays a role in how to select the appropriate PPE for dealing with chemical hazards.

A. PRINCIPLES OF TOXICOLOGY

Routes of Entry

The route of entry depends on the physical state and chemical properties of the substances.

Inhalation

Inhaling substances in the form of vapors, gases, mists, or particulates is one of the most common ways for a material (chemical) to enter a person's body system.

Absorption

Absorption via the skin, eyes, or mucous membrane can cause effects that are relatively innocuous, such as redness or mild dermatitis. More severe effects include destruction of skin tissue and various debilitating conditions. Many chemicals can also cross the skin barrier and be absorbed into the blood system, which can be life-threatening in some cases.

Ingestion

Chemicals that inadvertently get into the mouth and are swallowed do not generally harm the gastrointestinal tract itself unless they are irritating or corrosive.

Injection

Substances may enter the body if the skin is penetrated or punctured by contaminated objects. Effects can then occur as the substance is circulated in the blood and deposited in the target organs. Injection can also occur at the microscopic level, e.g., when a high-pressure line ruptures and the rapid release of the material breaks through the skin.

Modes of Action

Depending on the type(s) of exposure, there can be different interactions within the body. These interactions may be:

- Physical
- Chemical
- Physiological

Types of Exposure

The type of exposure can result in different effects to each individual person; i.e., how a chemical impacts one person might not be how it impacts another person.

Acute Exposure

- Short duration, often with high concentration
- One-time, limited, or short-term exposure
- Effects may not manifest immediately
- Usually reversible

Chronic Exposure

- Extended duration, often with low concentration
- Continuous, repeated, or long-term exposure
  - » Often irreversible damage

Degree of Exposure

The way a chemical will react with the body depends on a variety of different factors. These factors make up the degree of exposure:

- Route of exposure
- Properties of the chemical
- Dose
  - » Chemical + concentration + time = dose
- Frequency of exposure

Other factors that can affect the degree of exposure include:

- Genetics
- Sex (male/female)
- Health
- Age

- Environment
- Pregnancy

Measurements of Toxicity

Dose-response is a comparison of an organism's response to a given material at a specific dose.

An example would be inhaling ammonia gas. The response to inhaling ammonia might be watering of the eyes, irritation of the nose, mouth, and throat, and coughing.

The **dose-response curve** is used to identify when a material is safe if taken into the body system at a specific dose. A material that is normally thought of as harmless may induce a toxic response if taken into the human body in sufficient amounts.

An example would be pain pills. If a person takes medication as prescribed by a doctor, it will help to reduce the pain, ultimately being a positive dose-response relationship. But if a person takes an excess of pills over a shorter period of time, the medication can cause a negative effect on the living system.

Other ways to measure toxicity include:

- Identifying dose threshold for adverse health effects
- Toxicity rating
- Sources of information
  - » Human
  - » Epidemiological
  - » Animal

Lethal Dose vs. Lethal Concentration

Lethal dose (LD_{50}) is the amount of a material, given all at once, that causes the death of 50% of a group of test animals.

	LETHAL DOSE (LD_{50})	LETHAL CONCENTRATION (LC_{50})
RESULTS MEASURED	Only deaths measured	Only deaths measured
EXPRESSED	mg/kg	ppm or mg/m^3
ROUTES OF ENTRY	Absorption, Ingestion	Inhalation

LD_{50} is one way to measure the short-term poisoning potential (acute toxicity) of a material.

Exposure Limits – Regulations

Permissible Exposure Limits (PELs): Regulated by OSHA, set exposure limits for a time-weighted average (TWA), typically an 8-hour workday of a 40-hour workweek.

Short-Term Exposure Limits (STELs): Regulated by OSHA, set 15-minute exposure limits.

Ceiling Limit (C): The ceiling limit is the amount that is never safe for any period of time.

Exposure Limits – Guidelines

Recommended Exposure Limits (RELs): The National Institute for Occupational Safety and Health (NIOSH) provides these recommendations to OSHA for a 10-hour workday during a 40-hour workweek.

Immediately Dangerous to Life or Health (IDLH): Established by NIOSH as the level of exposure to airborne contaminants that is likely to cause death.

Threshold Limit Values (TLVs): Established by the American Conference of Governmental Industrial Hygienists (ACGIH) for an 8-hour workday of a 40-hour workweek.

Distribution, Biotransformation & Elimination

Distribution refers to the way in which a substance is circulated throughout the body. The most common distribution mechanisms are:

- Blood
- Lymphatic system
- Mucous membranes

Bioaccumulation is the accumulation of substances within an organism.

Biotransformation is the process by which a chemical is transformed into another chemical within the body. Biotransformation includes:

- Metabolism
- Detoxification

Elimination is the removal of a substance (by metabolism or detoxification) via any of several different pathways, including:

- Perspiration

- Exhalation
- Excretion
- Expulsion

B. RESPIRATORY TOXIC HAZARDS

Asphyxiants

Simple asphyxiants are gases that displace air at high concentrations.

Chemical asphyxiants are gases that prevent tissue from getting enough oxygen.

Irritants

Irritants are chemicals that aggravate the air passages, causing constriction of these pathways. Irritants can also cause fluid buildup or infection in the lungs.

Upper-respiratory irritants are substances that affect the upper respiratory tract (nose, mouth, trachea, lungs). They are usually water-soluble. Examples include:

- Hydrogen chloride
- Ammonia
- Methylamine

Lower-respiratory irritants are substances that affect the part of the lungs where oxygen exchanges with cells. They are usually not water-soluble. Examples include:

- Phosphine
- Nitrogen dioxide

C. SYSTEMIC TOXINS

Systemic toxins are chemicals that target specific organs or systems throughout the body. These chemicals will affect:

- Central nervous system
  - » Asphyxiants
  - » Hydrocarbons
  - » Metals
- Circulatory system
  - » Gases
  - » Aromatic solvents
- Liver
  - » Chlorinated solvents
  - » Hydrocarbons
  - » Aromatic compounds
- Kidney
  - » Halogenated compounds
  - » Metals
- Spleen
  - » Halogenated aromatic compounds
- Reproductive systems
  - » Aromatic hydrocarbons
  - » Pesticides
  - » Organic metals

D. EXTERNAL TOXINS

External toxins are chemicals outside the body that target the skin or eyes. External toxics may also increase other chemicals' ability to be absorbed.

Skin

- Solvents
- Oils
- Metals
- Corrosives
- Hazards
  - » Irritation
  - » Necrosis
  - » Removal of fat or keratin
  - » Ulceration
  - » Allergenic
  - » Sensitization
  - » Carcinogenic

Eyes

- Caustics

- Acids
- Solvents
- Oils
- Lachrymators
- Effects
  - » Lacrimation
  - » Irritation
  - » Necrosis
  - » Opacity
  - » Optic nerve damage

E. SPECIAL TOXINS

Carcinogens are materials that cause uncontrolled cell growth (cancer). Unlike with other toxins, carcinogen exposure often occurs in very small amounts over an extended period of time. The effects of carcinogens usually take many years to become evident and are more likely to occur after chronic exposure.

Mutagens are agents that cause changes in an organism's genetic code, which can affect an individual and/or be inherited by offspring.

Teratogens are agents that cause non-lethal congenital malformations.

Reproductive toxins are agents that cause lethal congenital malformations.

SECTION V: BIOLOGICAL HAZARDS

There are a variety of biological hazards to which personnel may be exposed while performing work. These hazards may include animal bites and stings, contact with poisonous plants, and exposure to pathogenic microorganisms.

A. ANIMAL BITES & STINGS

Large Animal Bites

Large animals, such as dogs, cats, or rodents, can often be found at worksites. Bites from these animals can carry a variety of hazards.

Dogs

- Laceration, puncture, severe tissue damage, and death can occur from large dog bites
- Bites may become infected or diseased

Cats

- Sharp fangs can cause very deep and easily infected puncture wounds — deep wounds are more difficult to treat effectively
- Bites may become infected or diseased

Rodents

- More often carry diseases than domesticated animals
- Greater possibility of transmitting rabies

While most large animal bites can be treated with soap and water, some may require medical attention.

Snake Bites

Snakes can produced venom, which is injected when they bite. Venom may be hemotoxic, neurotoxic, or both.

A **hemotoxin** is a toxin that destroys red blood cells, disrupts blood clotting, and/or causes organ degeneration and generalized tissue damage.

A **neurotoxin** is a toxin that works to disrupt the function of the brain and nervous system; classically, this venom causes paralysis or lack of muscle control, but it can also disrupt the individual signals sent between neurons and muscles.

There are four types of venomous snakes in the United States.

Rattlesnake

- The only venomous snake native to California
- Found in the south, east, and southwest states
- Hemotoxic and neurotoxic venom

Copperhead

- Found in the eastern Gulf and southern states
- Hemotoxic venom

Coral

- Found in Arizona, northern Mexico, and the southwest corner of New Mexico
- Neurotoxic venom
- "Red touching yellow, can kill a fellow; red touching black, safe for Jack"

Cottonmouth

- Found in the southern and Gulf states
- Hemotoxic venom
- Semi-aquatic and aggressive
- Will stand its ground or even approach an intruder

If a snake bite occurs, be sure to calm the bite victim. Gently wash area with soap and water and remove any jewelry/material that may constrict swelling. Apply a cold, wet cloth over the bitten area and seek immediate medical attention.

CAUTION: In the event of a snake bite:

- **Do not** apply a tourniquet
- **Do not** pack the bite area in ice or ice water
- **Do not** cut the wound with a knife or razor
- **Do not** attempt to suck out the venom by mouth
- **Do not** let the victim drink alcohol

Bee, Wasp, Hornet & Yellow Jacket Stings

Approximately 5% of the population is allergic to bee, wasp, hornet, and yellow jacket venom. Anaphylaxis is a severe allergic reaction to bee stings, is potentially life-threatening, and requires emergency treatment. About 3% of people who are stung by a bee or other insect develop anaphylaxis.

Signs and symptoms of anaphylaxis include:

- Difficulty breathing
- Swelling of the throat and tongue
- A weak and rapid pulse
- Nausea, vomiting, or diarrhea
- Dizziness or fainting
- Loss of consciousness

People who have had a severe allergic reaction to a bee sting have a 30% to 60% chance of anaphylaxis the next time they are stung. Those who have had such a reaction should talk to their doctor or an allergy specialist about prevention measures, such as immunotherapy, to avoid a similar reaction in case they are stung again.

Scorpion Stings

About 90 species of scorpions live in the U.S., and many of them are venomous. Signs or symptoms of a scorpion sting may include pain, numbness, swelling, and a tingling in the area around the sting. Severe symptoms may require medical attention.

If a scorpion sting occurs, remove the stinger (if there is one), wash the area with soap and water, and seek medical attention if needed.

Spider Bites

Many species of spiders bite, but only some are venomous. Spiders will not bite unless they or their web is disturbed. There are two common venomous spiders in the U.S.:

Black Widow

- Found in the southern and western states
- Identified by red "hour glass" coloration on the underside of the abdomen
- Painful bite, can cause severe muscle pain

Brown Recluse

- Found in the Midwest and southern states
- Also known as the "violin spider" for the dark violin-shaped marking on the head
- Initially painless bite, develops into necrosis

To treat a spider bite, start by cleaning the wound with soap and water. Then apply a cloth dampened with cold water or filled with ice to help reduce pain and swelling. If the bite is on an arm or leg, elevate it. Take an over-the-counter pain medication if needed.

B. POISONOUS PLANTS

There are many plants that are poisonous to humans, and those that produce skin irritations are the most concerning on the worksite. Symptoms include rashes, bumps, blisters, swelling, and itching.

The most common poisonous plants in the U.S. are poison oak and poison ivy. Both plants produce urushiol (yoo-roo-shee-ol), a colorless, odorless resin that causes a rash. Only 1 nanogram (billionth of a gram) is needed for a rash. Urushiol oil can stay active on any surface (including dead plants) for up to five years.

Poisonous plants are typically treated with soap, water, and anti-itch creams. In severe cases, it is recommended to seek medical attention.

C. VECTOR INFECTIOUS DISEASES

Vectors are living organisms that can transmit infectious diseases between humans or from animals to humans. Many of these vectors are bloodsucking insects, such as mosquitoes or ticks.

Hantavirus pulmonary syndrome (HPS) is a rare but potentially deadly disease transmitted by infected rodents through urine, droppings, or saliva. Humans can contract the disease when they breathe in the aerosolized virus. It was first recognized in 1993 and has since been identified throughout the United States. Rodent control in and around the home remains the primary strategy for preventing hantavirus infection.

Valley fever is a fungal disease caused by the inhalation of airborne fungal spores. The fungi that produce the toxic spores grow in the soil of California, Arizona, Nevada, New Mexico, Utah, Texas, and northern Mexico. The spores are swept into the air when the soil containing the fungus is disturbed. This disruption is commonly caused by construction, farming, or an earthquake. Valley fever causes flu-like symptoms such as fever, cough, headaches, rash, and muscle and joint pain. Most people who are exposed to the spores do not develop a disease. If symptoms do develop and are left untreated, valley fever can cause chronic

pulmonary infection.

Rocky Mountain spotted fever is the most severe and most frequently reported rickettsial illness in the United States. It also occurs in Mexico and in Central and South America. The disease is caused by *Rickettsia rickettsii*, a species of bacterium that is spread to humans by ixodid (hard-shelled) ticks. Initial signs and symptoms of the disease include sudden onset of fever, headache, and muscle pain followed by the development of a rash. The disease can be difficult to diagnose in the early stages and can be fatal without prompt and appropriate treatment.

Lyme disease is caused by the bacterium *Borrelia burgdorferi* and is transmitted to humans by the bite of infected blacklegged ticks. Typical symptoms include fever, headache, fatigue, and a characteristic skin rash called erythema migrans. If left untreated, infection can spread to joints, the heart, and the nervous system. Lyme disease is diagnosed based on symptoms, physical findings (e.g., rash), and the possibility of exposure to infected ticks; laboratory testing is helpful in the later stages of the disease. Most cases of Lyme disease can be treated successfully with a few weeks of antibiotics. Steps to prevent Lyme disease include using insect repellent, removing ticks promptly (ticks that transmit Lyme disease can occasionally transmit other tick-borne diseases), landscaping, and integrated pest management.

D. WATERBORNE DISEASES

Giardiasis is an infectious diarrheal disease caused by the parasite *Giardia lamblia*, which can be transmitted through oral-fecal contact and by water contaminated by feces. Symptoms include loss of appetite, diarrhea, loose or watery stools, stomach cramps, upset stomach, projectile vomiting, bloating, excessive gas, and burping.

Cholera is a diarrheal disease caused by the consumption of water or food contaminated with the bacterium *Vibrio cholerae*. The main symptoms are watery diarrhea and vomiting, which may result in dehydration and grayish-bluish skin in severe cases.

E. BLOODBORNE PATHOGENS

Bloodborne diseases are addressed in 29 CFR 1910.1030 (OSHA) and 8 CCR 5193 (Cal/OSHA). These regulations require the employer to establish a written Exposure Control Program and to use **universal precautions**, meaning that all human blood and certain human body fluids are treated as if known to be infectious. This approach often utilizes "work practice controls" (including PPE) that minimize or eliminate employee exposure.

Hepatitis A is a vaccine-preventable, communicable disease of the liver. It is caused by the hepatitis A virus (HAV) and causes acute liver inflammation. It is easily spread from person to person, usually through contaminated food and water, and almost always gets better on its own.

Hepatitis B is an infectious disease of the liver caused by the hepatitis B virus (HBV). It is transmitted through exposure to infected blood or body fluids. The virus can live for up to one month in dried blood and is 50 to 100 times more infectious than HIV. There is no cure, but there is a preventative vaccine.

Hepatitis C is an infectious disease of the liver caused by the hepatitis C virus (HCV). It is transmitted through exposure to infected blood or body fluids. With four million infected, hepatitis C is the most common chronic bloodborne infection in the United States and is the leading cause of liver transplantation. There are 35,000 new infections and 8,000 – 10,000 deaths from chronic disease each year.

Human immunodeficiency virus (HIV) is a virus that leads to **acquired immunodeficiency syndrome (AIDS)**. HIV is spread through contact with infected blood and some body fluids. HIV infects cells involved with the body's immune system, lowering the ability to fight off infections. Early symptoms are fever, loss of appetite, weight loss, chronic fatigue, and skin rashes. Later, as the disease progresses, cancer or infections such as pneumonia cannot be fought off. There is no cure for HIV, but antiviral therapy is used to slow the progression of the disease.

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SECTION VI: PHYSICAL HAZARDS

Hazardous waste operations often involve potential exposure to a wide range of physical hazards associated with equipment operations, use of protective clothing, and worksite conditions.

An **accident** is an undesired event that results in personal injury or property damage.

An **incident** is an unplanned, undesired event that adversely affects completion of a task.

A **near miss** is an incident in which no property was damaged and no personal injury was sustained, but damage and/or injury easily could have occurred given a slight shift in time or position.

Exposure to physical hazards such as confined spaces, excavations, drum handling, ladders, poor-visibility environments, etc., can result in accidents/incidents including slips, trips, and falls, electrical shock, and temperature and radiation stress, among others.

A. MATERIALS HANDLING

Accidents related to the manual handling of materials, which commonly result in back injuries, are primarily the result of unsafe working habits, improper lifting, carrying a load that is too heavy, incorrect gripping, and/or failing to wear personal protective equipment.

Improper materials handling can result in:

- Back injuries
- Body strains
- Blocked pathways
- Fall/crushing hazards

Proper Lifting

Proper lifting techniques include:

- Get a good footing
- Bend knees to pick up load
- Keep back straight
- Get a firm grip
- Lift gradually and keep materials close to the body
- Wear protective equipment like belts, safety shoes, and gloves

If the load is too heavy, do not try to lift it alone. Find someone who can help carry it, or break the load into smaller, more manageable loads, if possible. Use mechanical aids or assistance when possible.

B. COMPRESSED GAS CYLINDERS

Compressed gas cylinders can contain many different chemicals. These chemicals can be toxic, flammable, oxidizing, corrosive, or inert.

Since the gases are contained in heavy, highly pressurized metal containers, the large amount of potential energy resulting from compression of the gas makes the cylinder a potential rocket or fragmentation bomb. Damage can occur to a cylinder from falling / tipping over, heat, electrical circuits, motion, vibration, or anything that can cause weakness or cracks in the cylinder wall or shell.

These basic safety guidelines should be used when working with compressed gas cylinders:

- Select the least hazardous gases that will work
- Purchase only the necessary quantities

When receiving gas cylinders:

- Check for leaks
- Visually inspect the cylinder for damage
- Ensure the valve cover and shipping cap are on
- Check for proper labeling

When moving cylinders:

- Use a cylinder cart
- Do not move a cylinder using its protective valve caps
- Do not drop cylinders or permit cylinders to strike each other or be handled roughly

When storing compressed gas cylinders:

- Store cylinders in an upright position
- Store cylinders in compatible groups
  - » Flammables away from oxidizers

  - » Corrosives away from flammables
  - » Full cylinders away from empties
  - » All cylinders away from corrosive vapors
- Keep oxygen cylinders a minimum of 20 feet from flammable gas cylinders or combustible materials
  - » If this cannot be done, separation by a non-combustible barrier at least 5 feet high and having a fire rating of at least one-half hour is required
- Secured firmly at all times
  - » Clamp and belt or chain, securing the cylinder to a wall between "waist" and "shoulder," are generally suitable
- Keep valve protective caps in place when the cylinder is not in use
- Utilize nesting by ensuring each cylinder has three points of contact with either a wall or another cylinder

C. HEAT STRESS

Excessive heat and humidity affect the body's blood circulation and can cause cramps, burns/rashes, and general discomfort. This effect can manifest in heat rash, heat cramps, heat exhaustion, and heat stroke. Worker training is an essential element of an effective extreme temperature prevention program. Identifying the symptoms of heat stress will help prevent heat-related disorders, conditions, and possible death.

Heat Illnesses

Heat rash is caused by continuous exposure to heat or humid air and will result in redness accompanied with swelling and inflammation of the skin and small blisters — both symptoms commonly occur on the back of the neck.

Heat cramps are caused by heavy sweating and inadequate electrolyte replacement; a person suffering from heat cramps will experience muscle pain in the abdomen, arms, or legs, rapid heartbeat, and/or sweaty skin.

Heat exhaustion is caused by increased stress on various parts of the body, including inadequate blood circulation due to cardiovascular insufficiency or dehydration; signs to look for include pale, cool, moist skin, heavy sweating, rapid pulse, fainting, dizziness, and nausea.

Heat stroke is the most serious of all temperature-related disorders or conditions because temperature regulation fails and body temperature rises to critical levels. Immediate action should be taken to cool the body before serious injury or death occurs. Signs to look for include red, hot, usually dry skin, no perspiration, difficulty breathing, rapid pulse, dizziness, confusion, nausea, and, in extreme situations, coma.

Heat Stress Prevention

Employers are required to protect their employees from heat illness by:

- Providing heat illness prevention training
- Ensuring enough water is available
- Providing shade access and cool-down breaks
- Writing and enforcing heat illness prevention standard procedures, which must include provisions for:
  - » Access to water
  - » Access to shade
  - » Weather monitoring and acclimatization
  - » High-heat procedures
  - » Employee and supervisory training
  - » Written procedures, including emergency response

Employers must provide water that is fit to drink and should encourage employees to hydrate often.

Shade Requirements

At 80°F, shade must be made available to employees. When the work area temperature exceeds 80°F, the employer must maintain one or more areas with shade at all times while employees are present. When showing signs or symptoms of heat stress, employees are required to take a cool-down rest in the shade for a period of no less than 5 minutes at a time.

Shade is typically provided via shade structures. The shade must be at least large enough to accommodate the number of employees on recovery or rest periods

so they can sit in a normal posture fully in the shade without having to be in physical contact with each other. Additionally, the shaded area must not cause exposure to another hazard. Areas underneath mobile equipment or areas that require crouching in order to sit fully in the shade are not acceptable.

High-Heat Procedures

When the work area temperature reaches or exceeds 95°F, high-heat procedures must be implemented. High-heat procedures are of particular concern for agricultural, construction, landscaping, oil and gas extraction, and transportation industries.

Additional preventative measures should be followed once high-heat procedures are implemented. These measures include:

- Ensure effective communication by voice, observation, or electronic means
- Observe employees for alertness and signs and symptoms of heat illness
- Designate one or more employees on each worksite as authorized to call for emergency medical services
- Allow other employees to call for emergency services when no designated employee is available
- Remind employees throughout the work shift to drink plenty of water
- Conduct pre-shift meetings before the commencement of work to:
  - » Review the high-heat procedures
  - » Encourage employees to drink water
  - » Remind employees to take cool-down rests

D. COLD STRESS

When exposed to cold temperatures, the body begins to lose heat faster than it can be produced. Prolonged exposure to cold will eventually use up the body's stored energy, resulting in abnormally low body temperature. Once the body reaches 95°F, a person is hypothermic.

Hypothermia

Hypothermia, or abnormally low body temperature, is caused by prolonged exposure to cold and will result in stored energy being used up. A body temperature that is too low affects the brain, making the victim unable to think clearly or move well. Hypothermia is particularly dangerous because a person may not know it is happening and will not be able to do anything about it.

Symptoms of hypothermia can vary depending on how long an individual has been exposed to the cold temperatures. Early symptoms of hypothermia include shivering, fatigue, loss of coordination, confusion, and disorientation. Late symptoms include a lack of shivering, blue skin, dilated pupils, slowed pulse and breathing, and loss of consciousness.

Hypothermia treatment starts with alerting a supervisor and requesting immediate medical assistance. The victim should be moved to a warm room. After removing the wet clothing, the center of the body should be warmed first (chest, neck, head, and groin) to increase the victim's temperature. Warm (not hot) non-alcoholic liquids may be used to gently raise body temperature.

Being submerged in cold water can create a specific condition known as immersion hypothermia. This form of hypothermia can develop more quickly than standard hypothermia, as the cold water conducts heat away from the body 25 times faster than air. Survival odds may be improved by providing rescue means and ensuring proper clothing such as wool or synthetics is worn.

Frostbite

Frostbite is an injury to the body that is caused by freezing. It may cause a loss of feeling and color in the affected areas and most often affects the nose, ears, cheeks, chin, fingers, or toes. Frostbite can permanently damage body tissues, with severe cases sometimes requiring amputation.

In extremely cold temperatures, the risk of frostbite is increased in workers with reduced blood circulation and among workers who are not dressed properly.

To treat frostbite, transport the victim to a warm room as soon as possible. The affected area may then be immersed in warm (not hot) water. Do not allow the victim to rub or massage frostbitten areas, as doing so may cause more damage. Additionally, do not use a heating pad, fireplace, or radiator for warming frostbitten areas, as affected areas are

numb and can easily be burned without the victim noticing.

E. LONG SHIFTS

Employees are often required to work shifts longer than eight hours. Potentially hazardous work schedules may also include evening shifts, night shifts, rotating shifts, or other employer-arranged irregular schedules. The danger with working long shifts or irregular schedules is that attention to possible hazards begins to rapidly decrease. To combat this, ensure that employees are:

- Increasing breaks and rest
- Pacing meal breaks
- Taking 15- to 20-minute naps

F. POOR VISIBILITY

Under- or over-lighted areas can cause headaches, muscle strains, fatigue, and eye injury. This affects the body through reduced visual acuity and distractions from glare interference. Poorly lighted areas also provide an environment for slip, trip, and fall hazards. There are illumination requirements (measured in foot-candles) for hazardous waste operations.

- 3 foot-candles
  - » Excavation and waste areas, access ways, active storage areas, loading platforms, refueling, and field maintenance
- 5 foot-candles
  - » General site areas, warehouses, corridors, hallways, exits, tunnels, shafts, and general underground work areas
- 10 foot-candles
  - » General shop
- 30 foot-candles
  - » First aid stations, infirmaries, and offices

G. RADIATION

Radioactivity is classified into two basic types:

- Ionizing energy, which may break chemical bonds
  - » Alpha particles
  - » Beta particles
  - » Gamma particles
- Non-ionizing energy, which cannot break chemical bonds
  - » Ultraviolet or visible light
  - » Radio waves
  - » X-rays

Ionizing Energy

Alpha particles are heavy particles consisting of a positively charged helium nucleus. They are difficult to detect, and direct exposure is unlikely due to their limited mobility. Exposure can lead to severe lung and respiratory tract damage.

Beta particles are light and consist of electrons or positrons. They are also difficult to detect; however, beta particles can move farther than alpha particles. Exposure can lead to severe lung and respiratory tract damage.

Gamma rays are electromagnetic waves with no charge. They can travel many miles in the air, but small amounts are normal and innocuous.

Non-Ionizing Energy

While non-ionizing radiation cannot remove an electron from an atom, it can still be hazardous. Ultraviolet light is a non-ionizing radiation that can cause inflammation of the skin and eye (cornea). People who are often exposed to the full light of the sun may develop skin cancer.

Reduce radiation exposure by:

- Reducing time spent in radiation areas
- Wearing tinted protective eyewear or other protective equipment
- Covering up or using sun block on areas where the skin might burn

H. ELECTRICAL HAZARDS

Electrical hazards can exist because of exposed wiring, improper use of electrical equipment, or the presence of underground electric lines when digging or excavating. There are a few terms that are important to an understanding of electricity.

Voltage is the difference in electrical potential between two points in a circuit. It is the force that causes the flow of electricity. It can be compared to the pressure that causes water to move through a pipe. Voltage is measured in volts.

Current is the flow of electrical charge. It can be compared to the rate of flow of water in a pipe. Current is typically measured in amperes.

Resistance is similar to the effect of friction on the flow of water in a pipe. Resistance is measured in ohms.

Grounding is the process of mechanically connecting isolated wires and equipment to the earth.

When a person comes in contact with an electrical current, that person becomes a part of the circuit. The effects this has on the human body depend on many factors, the most important being the amperage of the current:

- 1 milliamp (mA): At a level that can usually be perceived, a slight tingling sensation; still dangerous under certain conditions
- 5 mA: Slight shock felt, not painful but disturbing; the average individual can let go; however, strong involuntary reactions to shocks in this range may lead to injuries
- 6 – 30 mA: Painful shock, muscular control is lost — this is called the "freezing current" or the "let-go range"
- 50 – 150 mA: Extreme pain, respiratory arrest, severe muscular contraction; the individual cannot let go, and death is possible
- 1,000 – 4,300 mA: Ventricular fibrillation ceases, muscular contraction and nerve damage occur, and death is likely
- 10,000+ mA: Cardiac arrest, severe burns, and probable death

Possible electrical hazards include:

- Performing unauthorized work
- No ground connection
- Using tools with defective insulation
- Using improper tools around flammable vapors or gases
- Not grounding and bonding when dispensing flammable liquids
- Working in wet areas
- Not using GFCIs
- Not using proper lockout/tagout (LOTO) procedures

I. LOCKOUT/TAGOUT

Using proper lockout/tagout procedures may help prevent electrocution incidents from occurring.

Energized means connected to an energy source or containing residual energy. An energy-isolating device is a mechanical device (e.g., disconnect switch, line valve, or block) that physically prevents the transmission or release of energy. The **energy source** is any source of electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or other energy.

Lockout refers to placement of a lockout device on an energy-isolating device, ensuring that the equipment cannot be operated until the device is removed. **Tagout** is placement of a tagout device on an energy-isolating device to indicate the equipment may not be operated until the device is removed.

Lockout/tagout (LOTO) procedures begin with a written program and training for affected and authorized employees. **Affected employees** are those required to operate or work around machines that are covered by LOTO. **Authorized employees** perform LOTO procedures on machines so they may perform service or maintenance operations. Authorized employees are the only ones authorized to enact LOTO on equipment.

LOTO Procedures

1. Prepare for shutdown
2. Notify co-workers
3. Shut down equipment
4. Isolate energy sources
5. Place locks & tags on equipment
6. Release stored energy
7. Verify equipment isolation

J. NOISE

Noise is any unwanted sound. High exposure to excessive noise over a long period of time may lead

to deafness and other audiological disorders. Short-term exposure can cause irritability and distraction.

The trigger for initiating a Hearing Conservation Program is 85 decibels (dB). This is also known as the action level. At this level, employers must make hearing protection available to employees.

Noise levels at or above 90 dB, and noise peaks above 100 dB, can cause headaches, increased blood pressure, muscle tension, and fatigue. The 90 dB threshold is also the permissible exposure limit (PEL). Employers must require hearing protection at this level.

Noise Reduction of Hearing Protection

The noise reduction rating (NRR) of hearing protection, which is the approximate decibel reduction provided by the protector in lab conditions, is measured in decibels. The NRR is found on the earmuff or earplug package — the higher the number, the greater the protection.

- Earplugs (preferred): NRR 20 – 30 dB
- Earmuffs (2nd choice): NRR 15 – 30 dB
- Double hearing protectors (plugs and muffs): NRR 30 – 40 dB — used for levels over 115 dB

K. LADDERS

Before using a ladder, each employee needs to be appropriately trained. Selecting the proper ladder for the job is the first step in helping to prevent accidents and injuries when working on a ladder. Consider the type, length, material, and strength of the ladder before using it.

When using a ladder:

- Angle the ladder properly
  - » The base should extend not less than one-fourth the ladder's length, and the minimum slope should be 50 degrees, with one foot from the building for every 4 feet of ladder length (4:1 ratio)
- Face the ladder when ascending or descending
- Maintain 3-point contact at all times
- Understand how to perform a complete inspection prior to each use
- Always use the ladder for its intended purpose and within its limits

L. FALL PROTECTION

Falls are among the most common causes of serious work-related injuries and deaths. Falls, or an uncontrolled descent, are the #1 killer in the construction industry. Falls from little as 4 feet can be serious and sometimes life-threatening.

Fall protection trigger heights:

- Code of Federal Regulations: 6 feet
- Construction Safety Orders: 7.5 feet

A **competent person** is one who is capable of identifying hazards in the surroundings and has authorization to eliminate them. A **qualified person** is an employee designated by the employer who has demonstrated the ability to safely perform all assigned duties and is properly licensed in accordance with federal, state, or local laws and regulations.

A **walking-working surface** is any surface, horizontal or vertical, on which an employee walks or works. An unprotected edge is any side or edge of a walking-working surface.

A **wall opening** is defined as one from which there is a drop of more than 4 feet and where the bottom of the opening is less than 3 feet above the working surface. A **floor opening** is any opening, 12 inches or more in the least horizontal dimension, in any floor or platform. A **floor hole** is any opening in a floor or platform that is smaller than a floor opening.

The **leading edge** is the edge of a floor, roof, or formwork for a floor or other walking-working surface (e.g., deck) that changes location as additional sections are placed, formed, or constructed.

Dangerous equipment is equipment that may be hazardous to employees who fall into or onto such equipment.

A **personal fall arrest system** is one that is used to stop an employee in a fall from a working level. A **personal fall restraint system** is one used to prevent an employee from falling. Examples:

- Full-body harness
- Self-retracting lifelines
- Lanyards
- Horizontal lifelines

SECTION VII: SPECIAL HAZARDS

A. CONFINED SPACES

A **confined space** is a space that meets all three of the following criteria:

- Is large enough and so configured that an employee can enter bodily and perform work
- Has limited or restricted means of entry or exit
- Is not designed for continuous human occupancy

A **non-permit-required confined space** is a confined space that meets all of the following criteria:

- Does not contain or have the potential to contain any hazard capable of causing death or serious physical harm
- Has an acceptable oxygen level of 19.5% – 23.5%
- Has a flammable atmosphere of ≤ 10% of the lower explosive limit (LEL)

A **permit-required confined space** is a confined space that meets at least one of the following criteria:

- Contains or has the potential to contain a hazardous atmosphere;
- Contains a material that could potentially engulf an entrant;
- Has an internal configuration such that an entrant could be trapped or asphyxiated by inwardly converging walls or by a floor that slopes downward and tapers to a smaller cross-section; AND/OR
- Contains any other recognized serious safety or health hazard

Alternate confined space procedures only apply if:

- The employer can demonstrate that the only hazard posed by the permit space is an actual or potential hazardous atmosphere AND continuous forced air ventilation alone is sufficient to maintain the permit space as safe for entry
- The employer develops monitoring and inspection data that supports the demonstrations required by 8 CCR 5157(c)(5)(A)(1&2)
- An initial entry of the permit space is necessary to obtain data required, then confined space permit guidelines are followed

Before entering a confined space, be sure to determine the kind of confined space.

Leading causes of confined space fatality are:

- Failure to recognize a confined space
- Failure to test the atmosphere prior to entry
- Failure to ventilate prior to and during entry
- Failure to recognize physical hazards

Employee Training

General requirements for confined space training:

- Train before assigning duties
- Train before changing duties
- Train whenever operations present a new hazard

Retrain whenever there is reason to believe:

- There are deviations from the established procedures
- There are inadequacies in employees' knowledge of procedures

Entry & Entrant

Entry is the act by which a person intentionally passes through an opening into a permit-required confined space. Any part of the body passing through the opening is considered entry — even if just reaching in to test the atmosphere.

The **entrant** is the employee who will physically enter the confined space to perform the work for any amount of time.

The entrant must:

- Know the hazards that may be faced during entry, including routes, signs, symptoms, and consequences of exposure
- Communicate with the attendant while in the space and alert the attendant if there are any warning signs or symptoms of exposure or if there is a prohibited condition

- Exit from space without question when an order is given by anyone involved in the operation or when there is a prohibited condition or an alarm
- Ensure that the space has been adequately ventilated, isolated, emptied, or otherwise made safe for entry
- Follow all applicable safety rules and procedures
- Be familiar with the work to be performed and the procedures that apply to the job
- Use the appropriate PPE whenever necessary

REMEMBER: If lockout/tagout is used, the key must be with the entrant while he/she is in the space.

Attendant

The **attendant** is the employee who remains outside the confined space and monitors the entrant(s), guards the space against unauthorized entry, warns the entrant(s) of any unusual conditions, and summons rescue personnel, if needed.

The attendant must be in CONSTANT COMMUNICATION with the entrant(s) and must:

- Maintain accurate count of all entrants in the space
- Remain outside of the space the entire time, unless relieved by another attendant
- Remain in constant communication with the entrant(s) during the operation and provide an alert if there is a need to evacuate the space
- Monitor activities inside and outside the space to determine if it is safe for entrant(s) to remain inside
- Initiate on-site rescue procedures and summon additional rescue and other emergency services as soon as the need for assistance arises
- Keep unauthorized personnel away from / out of the permit space
- Perform non-entry rescue or other rescue services as part of the employer's on-site rescue procedures
- Perform no other duties that might interfere with the primary duty of monitoring and protecting the authorized entrant(s)
- NOT rely on 911 for rescue services

REMEMBER: As an attendant, you could be the only lifeline for the entrant(s) in an emergency.

Entry Supervisor

The **entry supervisor** is the person (such as the employer, foreman, or crew chief) responsible for determining if acceptable entry conditions are present at a permit space where entry is planned, authorizing entry and overseeing entry operations, and terminating entry.

The entry supervisor must:

- Sign the entry permit to authorize entry
- Verify that all tests specified by the permit have been conducted and all procedures and equipment specified by the permit are in place before endorsing the permit and allowing entry
- Terminate the entry and cancel the permit as required by regulations
- Verify that rescue services are available and the means for summoning additional services are operable
- Remove unauthorized individuals who enter or attempt to enter the permit space during entry operations
- Determine, whenever responsibility for a permit space entry operation is transferred and at intervals dictated by the hazards and operations performed within the space, that entry operations remain consistent with the terms of the entry permit and that acceptable entry conditions are maintained
- Verify that all personnel have exited prior to closing the space

Examples of confined spaces include sewers, grain storage bins, boilers, tanks, vaults, pipelines, tank cars, and open pits.

Controlling the Confined Space

A confined space may be controlled by:

- Draining or pumping out any liquid contents
- Blanking off all in-feeding lines
- Air testing and ventilation
- Removal of any sludge from outside the

confined space

- Exiting space if conditions deteriorate

Testing the Atmosphere

The atmosphere within the space must be tested as necessary to ensure that the continuous forced air ventilation is preventing the accumulation of a hazardous atmosphere. Test for:

- Oxygen content
- Combustibles
- Toxic gases

Any time a limit is exceeded, no matter what the reason, all personnel must IMMEDIATELY EXIT the space, and no others may enter until atmospheric conditions are returned to safe levels.

Rescue

Self-rescue is having the entrant evacuate the space under his/her own power. This is the preferred method of rescue.

Non-entry rescue is the entrant evacuating on his/her own using a rescue device such as a full-body harness.

On-site rescue services are preferred, as what will be considered a timely rescue will vary according to the specific hazards involved in each entry. If off-site rescue cannot be provided quickly enough, then it is not a real option.

B. TRENCHING & EXCAVATING

Trenching is one of the most hazardous construction operations of all. Most accidents occur in trenches between 5 and 15 feet deep, and there is usually no warning before a cave-in occurs.

A **trench** is a narrow excavation (in relation to its length) made below the surface of the ground.

An **excavation** is any man-made cut, cavity, trench, or depression in an earth surface that is formed by earth removal.

A competent person performs daily inspections and has:

- Knowledge of the regulations
- Knowledge of soil analysis
- Knowledge of the use of protective systems
- The authority to take prompt corrective actions
- The ability to recognize and test for hazardous atmospheres

Overview

- The spoil pile needs to be at least 2 feet from the edge (may vary by county)
- When trench depth reaches 4 feet:
  - » Entry/egress must be within 25 feet
  - » Air monitoring and rescue equipment (SCBA, ventilation, rescue basket, etc.) are required for potentially hazardous atmospheres
- When trench depth reaches 5 feet or more:
  - » Protective systems are required
- When trench depth reaches 20 feet or more:
  - » All protective systems must be approved by a state-registered professional engineer

In California, trenching requires a permit. The California Labor Code requires that the applicant supply information necessary to evaluate the safety of the workplace subject to permit requirements. A permit will not be issued until evidence has been demonstrated that the place of employment will be safe and healthful.

Soil Types

- Soil Type A
  - » Most stable: clay, silty clay, and hardpan (resists penetration)
- Soil Type B
  - » Medium stable: silt, sandy loam, medium clay, and unstable rock
- Soil Type C
  - » Least stable: gravel, loamy sand, soft clay, submerged soil, or dense, heavy, unstable rock
- Stable rock
  - » Excavating makes this soil unstable (unlikely to be worked in)

Employee Protection

Employees must be protected from potential falling hazards, such as:

- Loose rock or soil
- Excavated or other materials
- Excavation equipment

Protection must be provided by placing and keeping such materials or equipment at least 2 feet from the edge of excavations. Each employee in an excavation must be protected from cave-ins by an adequate protective system when the trench depth reaches 5 feet.

Examples of protective systems:

- Shoring, sloping, and benching
- Support walls designed to prevent cave-in

C. HEAVY EQUIPMENT

Mobile construction equipment is often used by contractors doing a variety of work. Training is vital, as heavy equipment possesses the capability to cause serious injury or death. Heavy equipment includes loaders, bulldozers, hauling vehicles, pavement rollers, concrete mixers, and water trucks.

Before moving any equipment, first perform a vehicle walk-around. This is typically done at the beginning of every shift and includes the following:

- Brake and wheel inspection
- Leak inspection
- Safety equipment
- Controls
- General maintenance

Employees exposed to vehicular traffic must wear high-visibility clothing when working around heavy equipment. A system of traffic control must be implemented, and backup alarms must be audible from 200 feet away or there must be a flagger in clear view of the operator.

Equipment operators must be aware of workers on foot, and employees working around heavy equipment must "see and be seen."

SECTION VIII: HAZARD ASSESSMENT

A **hazard** is something that can cause harm.

A **risk** is the likelihood or possibility that a hazard may cause harm.

The process of evaluating both of these together is called **hazard assessment**, the dynamic and continuous process of identifying hazards and evaluating risks for the purpose of safety decision-making.

A. DEFINITIONS

Ambient Conditions: Weather and off-site targets.

Analytical Sampling: Field sampling and analysis.

Field Monitoring Device: Portable, direct-reading instrument.

Field Testing: Field chemical test of obtained sample.

Field Observations: Direct visual observations.

Industrial Hygiene: Analysis of air samples.

Operations: The equipment, procedures, and tasks involved in a project.

Physical Environment: The physical surroundings.

Site Characterization: Background data/research.

B. HAZARD ASSESSMENT STAGES

1. Off-site: Initiation of the assessment.

2. Reconnaissance: On-site update of the initial assessment.

3. On-site: Initial entry to systematically update the assessment.

4. Update: Continuous update on new observations and findings.

C. HAZARD ASSESSMENT STEPS

1. Hazard Recognition: Identify all actual and potential field hazards. Hazard recognition begins with understanding normal operations, equipment, and hazards. Imagination must be utilized in order to consider all possibilities.

2. Evaluation Assessment: Measure the severity of each identified hazard. After the hazards have been identified, they are measured to determine their individual and aggregate severity.

3. Comparison Assessment: Once the hazards have been measured via evaluation assessment, each measured value is compared to safety standards/guidelines.

4. Hazard Prioritization: Prioritize or rank each hazard based on the severity, and mitigate them in this order to best keep employees safe.

5. Hazard Control: Control the hazard(s) by selecting measures necessary to protect people, the environment, and property. Reevaluate the interaction of controls and hazards when necessary.

D. SITE CHARACTERIZATION

The purpose of site characterization is to anticipate common and suspected hazards, identify and obtain appropriate safety equipment, and incorporate safety procedures into a site's operations plan.

Site characterization requires the following information:

- Type of work performed
- Duration and location of activities
- Materials to be handled

E. HAZARD ASSESSMENT CLASSIFICATIONS

Determination of a hazard is typically done through a job safety analysis (aka “job hazard” or “activity hazard analysis”). Hazards can be classified as follows:

- Slip/trip/fall
- Hand or power tools
- Handling
- Machinery
- Fixed/flying/falling objects
- Transport

- Electricity
- Confined spaces
- Lone working
- Lighting
- Thermal environment
- Repetitive working
- Chemicals
- Noise/vibration
- Fire/explosion
- Hot surfaces

F. SOURCES OF INFORMATION

Hazard assessment sources of information include:

- Site characterization
  - » Background data/research
- Field monitoring
  - » Portable direct reading instrument
- Field testing
  - » Field chemical test of obtained sample
- Field observation
  - » Direct visual observations
- Industrial hygiene
  - » Analysis of air samples
- Analytical sampling
  - » Field sampling and analysis

SECTION IX: HAZARD WARNING SYSTEMS

A. HAZARD COMMUNICATION

OSHA regulations require that employees be made aware of hazardous substances in the workplace. In general, all employees should be apprised of the hazardous properties of chemicals that they may encounter along with measures to take to protect themselves from those chemicals.

The standard requires that employers inventory all hazardous chemicals in the workplace and include that inventory as a part of the written hazard communication program. This inventory will eventually serve as a master list for which a Safety Data Sheet (SDS — formerly Material Safety Data Sheet) must be obtained and maintained.

Employee Information & Training

The hazard warning system provides workers the "right-to-know" concerning the hazards and identities of the chemicals they are, or may have the potential to be, exposed to in the workplace.

Employee information must include:

- Hazard Communication Standard (HCS) requirements
- Operations in the work area involving hazardous chemicals
- Location and availability of HCS program and SDSs

Employee training must include:

- How to detect presence and release
- Physical and health hazards
- Measures for employees to protect themselves
- Details of the HCS program

The employee training must be conducted within the first 30 days of employment.

B. CHEMICAL INVENTORY & LABELING

Chemical inventories must include explosives, gases, flammable liquids/solids, oxidizers, organic peroxides, toxic materials, infectious substances, radioactive materials, and corrosive materials.

Containers of hazardous chemicals must be labeled, tagged, or marked with the identity of the material and appropriate hazard warnings.

Labeling requirements do not apply to:

- Any pesticide as defined by the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA) when labeled accordingly
- Any food additive, color additive, drug, or cosmetic defined by the Food and Drug Administration (FDA)
- Any distilled spirits defined by the Food Allergy and Anaphylaxis Alliance (FAAA)
- Any consumer products or hazardous substances defined by the Consumer Protection Association (CPA)

C. GLOBALLY HARMONIZED SYSTEM (GHS)

The Globally Harmonized System (GHS) for hazard communication includes the appropriate labeling tools to convey information about each of the hazard classes and categories in the GHS. The use of symbols, signal words, or hazard statements, other than those that have been assigned to each of the GHS hazard classes and categories, would be contrary to harmonization.

Signal Words

Companies are required to place a **signal word** on the labels and SDSs for the materials that they distribute. The signal word indicates the relative degree of severity of a hazard. Signal words are standardized as follows:

- **"Danger"** for the **more** severe hazards
- **"Warning"** for the **less** severe hazards

Some lower-level hazard categories do not use signal words. Use only one signal word corresponding to the class of the most severe hazard.

Hazard Communication Standard – Globally Harmonized System

HEALTH HAZARD	FLAME	EXCLAMATION MARK
• Carcinogens • Mutagenicity • Reproductive toxicity • Respiratory sensitizer • Target organ toxicity • Aspiration toxicity	• Flammables • Pyrophorics • Self-heating • Emits flammable gas • Self-reactives • Organic peroxides	• Irritants (skin and eye) • Skin sensitizers • Acute toxicity (harmful) • Narcotic effects • Respiratory tract irritants • Hazardous to ozone layer [non-mandatory]
GAS CYLINDER	**CORROSION**	**EXPLODING BOMB**
• Gases under pressure	• Skin corrosion / burns • Eye damage • Corrosive to metals	• Explosives • Self-reactives • Organic peroxides
FLAME-OVER-CIRCLE	**ENVIRONMENT [NON-MANDATORY]**	**SKULL-AND-CROSSBONES**
• Oxidizers	• Aquatic toxicity	• Acute toxicity (fatal or toxic)

D. SAFETY DATA SHEETS (SDSs)

The HCS [29 CFR 1910.1200(g)], revised in 2012, requires that the chemical manufacturer, distributor, or importer provide SDSs (formerly MSDSs, or Material Safety Data Sheets) for each hazardous chemical to downstream users to communicate information on these hazards. The information contained in the SDS is largely the same as the MSDS, except that the SDSs are required to be presented in a consistent, user-friendly, 16-section format.

An SDS should be produced for all substances and mixtures that meet the GHS criteria for physical, health, or environmental hazards.

- Section 1: Identification of the supplier and the substance or mixture
- Section 2: Hazard(s) identification
- Section 3: Composition / information ingredients
- Section 4: First aid measures
- Section 5: Firefighting measures
- Section 6: Accidental release measures
- Section 7: Handling and storage
- Section 8: Exposure controls / personal protection
- Section 9: Physical and chemical properties
- Section 10: Stability and reactivity
- Section 11: Toxicological information
- Section 12: Ecological information
- Section 13: Disposal considerations
- Section 14: Transport information
- Section 15: Regulatory information
- Section 16: Other information, including preparation and revision of the SDS

E. SHIPPING PAPERS

Paperwork must accommodate the transportation of hazardous materials. Different forms of paperwork are:

- Highway – Bill of lading, shipping papers, Uniform Hazardous Waste Manifest
- Rail – Waybill and Consist
- Water – Dangerous Cargo Manifest
- Air – Airbill

F. DOT LABELING

The Department of Transportation (DOT) mandates that certain vehicles that transport hazardous materials are labeled and placarded according to the regulations. DOT identifies nine hazard classes, each with its own special properties. Some of these hazard classes are further broken down into divisions. DOT uses placards and labels to help easily identify the hazards associated with these materials.

The identification number identifies the chemical being transported. "UN," indicating internationally transported chemicals, or "NA," for chemicals transported in the U.S. and Canada, precedes the number. In addition to these placards, the UN number may also be inset into the appropriate placard.

Placards are used on bulk containers and are displayed on all four sides. The placards must be 10 ¾ by 10 ¾ inches point-on-end. Labels are used on non-bulk containers of hazardous materials and must be 3.9 inches (100 mm) by 3.9 inches (100 mm) point-on-end.

See page 12 for a full list and description of DOT placards and labels.

G. NFPA 704 SYSTEM

NFPA 704 is a standard maintained by the National Fire Protection Association that presents a simple, readily recognized, and easily understood system of markings, referred to as the "Fire Diamond," that provides an immediate general sense of the hazards of a material and the severity of these hazards as they relate to emergency response.

NFPA 704 provides criteria for assessing the health, flammability, instability, and related hazards that are presented by short-term, acute exposure to a material under conditions of fire, spill, or similar emergencies. A number rating system of 0 to 4 is provided to rate each of the four hazards and is placed on a placard. This placard provides emergency responders with the information they

need to determine the immediate actions to be taken in an emergency. Tables in the standard provide the criteria for the ratings and placard specifications, such as letter size and arrangement of numbers and colors that are provided in the standard.

H. HAZARDOUS MATERIALS IDENTIFICATION SYSTEM (HMIS®)

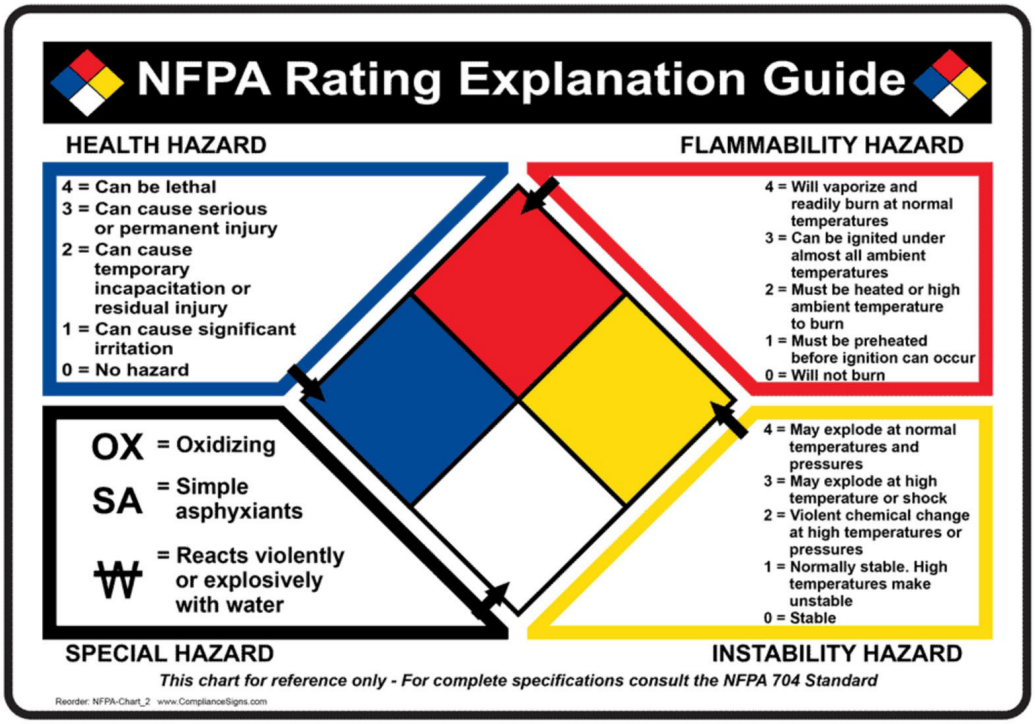
The American Coatings Association (ACA) developed the Hazardous Materials Identification System (HMIS®) to aid employers in the implementation of an effective Hazard Communication Program. The third version of this system, HMIS® III, offers comprehensive resources covering hazard assessment, hazard communication, and employee training. HMIS® III Hazard Assessment helps define the health, flammability, and physical hazards of different chemicals and shows how to communicate those hazards with a label that incorporates color-coded fields along with a recommendation for personal protective equipment.

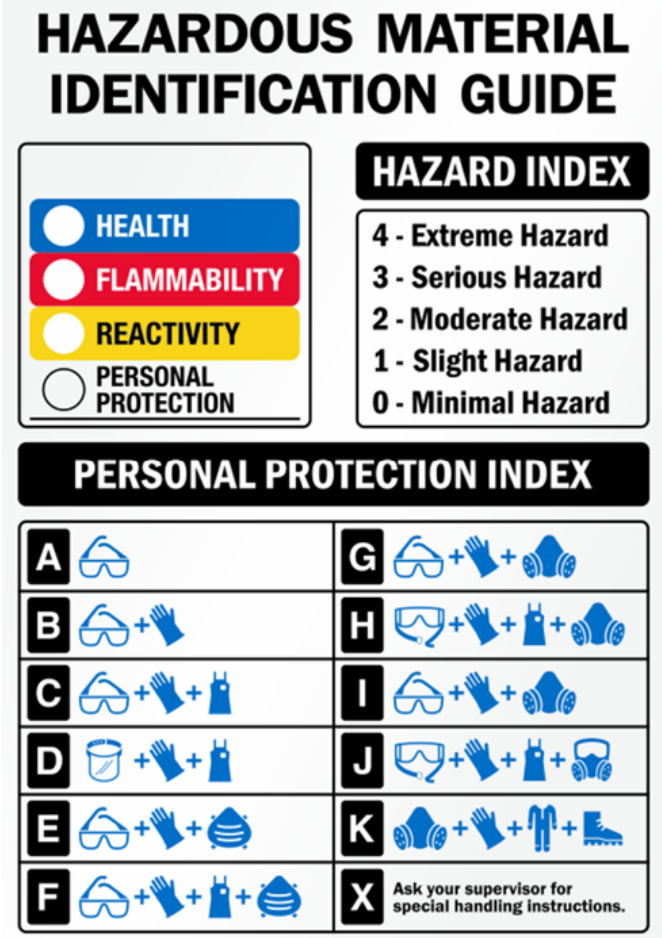
I. EMERGENCY RESPONSE GUIDEBOOK (ERG)

The Emergency Response Guidebook (ERG) was developed for use by firefighters, police, and other emergency services personnel who may be the first to arrive at the scene of a transportation incident involving dangerous goods. It is primarily a guide to aid first responders in quickly identifying the specific or generic hazards of the material(s) involved in the incident and for protecting themselves and the general public during the initial response phase of the incident. For the purposes of the ERG, the "initial response phase" is that period following arrival at the scene of an incident during which the presence and/or identification of dangerous goods is confirmed, protective actions and area securement are initiated, and assistance of qualified personnel is requested. It is not intended to provide information on the physical or chemical properties of dangerous goods.

After obtaining the identification number, consult the ERG:

- The white pages tell how to use the book and include placard and container identification information
- The yellow pages list the materials in numerical order by UN ID number
- The blue pages list the materials in alphabetical order
- The orange-bordered pages list 174 individual guide numbers associated with emergency response actions for particular materials
- The green-bordered pages give initial isolation and protective action distances and toxic inhalation hazards for the highlighted entries in the yellow and blue sections (IIPAD, TIH)
  - » Table 1: Initial Isolation and Protective Action Distances
  - » Table 2: Water-Reactive Materials which Produce Toxic Gases
  - » Table 3: Initial Isolation and Protective Action Distances for Large Spills for Different Quantities of Six Common TIH (PIH in the US) Gases


NFPA Rating Explanation Guide
HEALTH HAZARD
4 = Can be lethal
3 = Can cause serious or permanent injury
2 = Can cause temporary incapacitation or residual injury
1 = Can cause significant irritation
0 = No hazard
FLAMMABILITY HAZARD
4 = Will vaporize and readily burn at normal temperatures
3 = Can be ignited under almost all ambient temperatures
2 = Must be heated or high ambient temperature to burn
1 = Must be preheated before ignition can occur
0 = Will not burn
OX = Oxidizing
SA = Simple asphyxiants
W = Reacts violently or explosively with water
SPECIAL HAZARD
4 = May explode at normal temperatures and pressures
3 = May explode at high temperature or shock
2 = Violent chemical change at high temperatures or pressures
1 = Normally stable. High temperatures make unstable
0 = Stable
INSTABILITY HAZARD
This chart for reference only - For complete specifications consult the NFPA 704 Standard
Reorder: NFPA-Chart_2 www.ComplianceSigns.com


HAZARDOUS MATERIAL IDENTIFICATION GUIDE
HEALTH
FLAMMABILITY
REACTIVITY
PERSONAL PROTECTION
HAZARD INDEX
4 - Extreme Hazard
3 - Serious Hazard
2 - Moderate Hazard
1 - Slight Hazard
0 - Minimal Hazard
PERSONAL PROTECTION INDEX
A
B
C
D
E
F
G
H
I
J
K
X
Ask your supervisor for special handling instructions.

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SECTION X: PERSONAL PROTECTIVE EQUIPMENT

The harmful effects of specific chemical hazards may necessitate the use of personal protective clothing and equipment when responding to a chemical emergency. Protective equipment should only be used when engineering and administrative controls are not feasible or adequate.

To ensure proper effectiveness, safe work practices must always be implemented when using personal protective equipment (PPE). Proper use and selection are achieved by balancing the protection afforded by the items and the potential hazards caused by their use. The various stages of chemical emergency response usually necessitate the use of different types of protective items.

A. SELECTION CRITERIA

Hazard assessment:

- Type of hazard
- Degree of hazard
- Duration of activity (exposure)
- Nature of activity

Performance requirements:

- Strength and resistance
- Flexibility
- Temperature limits
- Durability
- Cleanability

Chemical resistance:

- Degradation
- Permeation
- Penetration

Protective materials:

- Elastomers
- Laminates

B. ITEMS/EQUIPMENT

Disposable: Equipment that must be removed and disposed of after each use.

Reusable: Equipment that must be cleaned and inspected after each use.

Levels of protection:

- Level A: Fully encapsulating suit and self-contained breathing apparatus (SCBA)
- Level B: Full-body suit and SCBA or airline respirator
- Level C: Protective suit and air-purifying respirator
- Modified level D: Chemical protective suit, no respiratory protection
- Level D: Work uniform, high-visibility vest, eye and head protection, no respiratory protection

Personal protective equipment may consist of suits, boots, booties, gloves, etc. Implementation and testing standards may be voluntary or required.

- ASTM International (formerly known as American Society for Testing and Materials)
- American National Standards Institute (ANSI)
- National Fire Protection Association (NFPA)
- NIOSH (National Institute for Occupational Safety and Health)

C. PROTECTION TYPES

Hard Hats

- Class C: No voltage protection
- Class G: Limited protection (up to 2,200 volts)
- Class E: High protection (up to 20,000 volts)

Eye & Face Protection

Safety glasses:

- Minimum requirement

Goggles:

- Protection from chemicals, splashes, dust, or projectiles

Face shield:

- Protection from splashes or projectiles

Chemical splash hood:

- Shoulder-length or longer

Hand Protection

Gloves/sleeves:

- General duty
  - » Cotton
  - » Leather
- Sharp objects
  - » Leather
  - » Kevlar
- Chemical
  - » Multiple types

Foot Protection

Shoes/boots:

- Steel toe
  - » Compression, puncture
- Composite toe
  - » Compression, impact
- Metatarsal guards
  - » Protects top of foot behind the toe
- Chemical-resistant
  - » Prevents contact with chemicals

D. DETERMINING USE

Prior to use:

- Assess hazards and operational requirements
- Properly select equipment
- Plan and prioritize activities
- Anticipate emergencies

During use:

- Conduct periodic integrity checks
- Monitor for heat stress
- Implement safe work activities
- Avoid false sense of security
- Always use within limits

After use:

- Visual check
- Pressure check
- Store properly

SECTION XI: SITE CONTROL

The purpose of **site control** is to reduce or prevent the spread of contamination by establishing artificial and/or physical barriers to isolate the site from potential targets. Site control must be site-specific.

A. DEFINITIONS

Exclusion Zone / Hot Zone: Encompasses all known or suspected hazardous materials.

Contamination Reduction Zone (CRZ) / Warm Zone: Between the exclusion zone and the support zone. The **contamination reduction corridor** (decon area) is established within this zone.

Support Zone / Cold Zone: The area outside the contamination reduction zone where equipment and rescue personnel are stationed.

Decontamination (Decon): The removal of hazardous substances; involves primary and backup emergency decon personnel.

Buddy System: Paired personnel system that promotes communication, safety, integrity checks, and shared work load.

Site Security: System that keeps out unauthorized personnel.

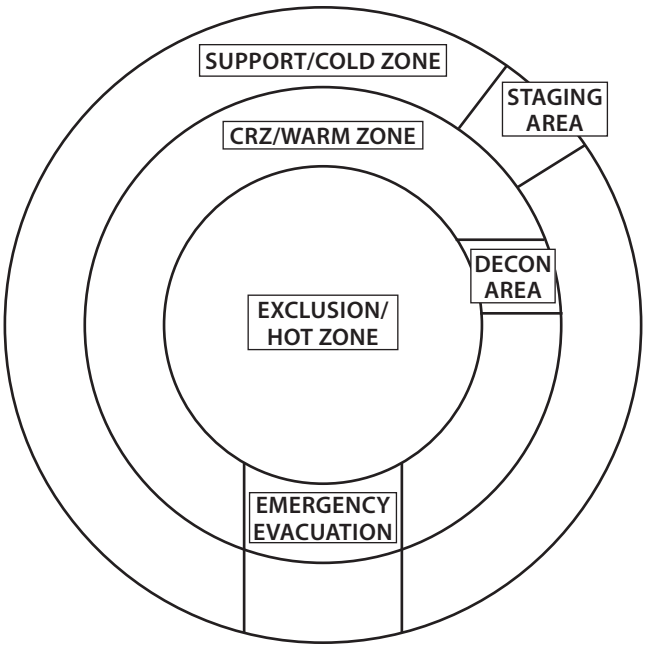
Communication System: System that promotes communication, such as safety briefings, barrier tapes, radios, air horns, etc.

Safe Work Practices / Exposure Minimization: Actions used to prevent contamination.

Emergency Plans: Site evacuation routes, emergency decontamination, regroup area, etc.

B. APPLICATION

Site control is implemented by establishing work zones, decontamination practices, communication procedures, and safe work practices.



C. IMPLEMENTATION

Site Map

A **site map** is a communication tool that is essential to site control. The site map shows a variety of information, including:

- Access and evacuation routes
- Areas requiring special PPE
- Landmarks and topographical features

Maps are ever-changing and are influenced by:

- Changes in site activities
- Unanticipated hazards
- Accidents and emergencies

Site Preparation

The key focus of site preparation is worker safety. Some of the major steps for site preparation include:

- Constructing roadway(s)
- Arranging traffic flow patterns
- Eliminating physical hazards (when possible)

Site Zones

Site zones are developed to ensure that:

- Personnel are protected against hazards specific to where they are working
- Contamination is confined to designated areas
- Personnel can be located and evacuated in an emergency

The size and shape of each zone depends on the hazards present, such as:

- The nature and extent of the chemical hazard(s)
- Features of the site
- Potential for other accidents to occur
- Weather conditions
- Nature of the work
- Size of the contaminated area
- Off-site hazards

NOTE: Zones can change at any time during the operation.

SECTION XII: DECONTAMINATION

Decontamination is the process of reducing the amount of contamination on a surface to a safe, negligible level. The process of personal decontamination involves the cleaning and/or removal of protective clothing and equipment in a specific order and by specific methods so as to prevent contamination of clean surfaces.

A. PREPARATION

Preparation starts with anticipating the need for decontamination and ensuring that the necessary items are available and accessible. The type and extent of decontamination depends on the following:

- Toxicity: chemical and physical properties of the contaminants
- Amount of contaminants
- Type(s) of PPE required
- Work activities
- Anticipated use

B. CONTAMINATION

Contamination can occur when:

- Entry is gained to the exclusion zone without proper PPE
- Improper decontamination methods are used
- Wind direction or other environmental changes occur

The methods of contamination are:

- Direct contamination (heaviest levels of contamination)
  - » High-contact surfaces
  - » Hands
  - » Feet
- Indirect contamination (can adhere to PPE)
  - » Gases
  - » Vapors
  - » Dust

Prevention of contamination:

- Exposure minimization
- Safe work practices

C. DECONTAMINATION METHODS

There a two primary methods of decontamination: physical and chemical.

The **physical decon** (dry) method involves removing PPE to prevent cross-contamination.

The **chemical decon** (wet) method involves washing with a decon solution.

At a minimum, field decontamination must:

- Isolate the worker
- Provide a clearly designated zone with identified areas for each task
- Provide containment for disposable items
- Contain all waste streams and/or runoff
- Apply field practicality

D. DECONTAMINATION EMERGENCIES

Mild Emergencies

In mild emergencies, go to the decon station and perform decon procedures to exit the exclusion zone. The decon station must be set up a safe distance from the hazard. Mild emergencies include:

- Container spills
- Minor injury

Moderate Emergencies

In moderate emergencies, either go to the decon station and quickly perform decon procedures or bypass the decon station and move to a safer distance before removing PPE. Use your judgment to decide

between the options. Moderate emergencies include:

- Large spills
- Potentials for fire

Serious Emergencies

In serious emergencies, bypass the decon station and immediately move to a safer location, then remove PPE and leave it for later cleanup. The hands and face should be washed as soon as is practical. Serious emergencies include:

- Fires or explosions
- Large chemical reactions

Medical Emergencies

In a medical emergency, the following guidelines should be implemented:

- Remove protective clothing (unless the removal interferes with treatment, delays treatment, or aggravates the medical incident) and flush with copious amounts of water or soap and water solution
- Protect yourself while handling/treating the victim
- Alert the ambulance and medical personnel of the contaminant(s)

Whenever possible, decontamination procedures should be implemented in a medical emergency situation.

SECTION XIII: FIRE SAFETY

OSHA requires employers to provide proper exits, firefighting equipment, and employee training to prevent fire-related deaths and injuries in the workplace.

A. OVERVIEW

Fire Control

The elimination of the causes of fires is critical to reducing costs. Fire control:

- Keeps a fire from spreading
- Keeps building structure intact
- Maintains both conditions long enough for intervention

Causes of Fires

The top three ignition sources are:

1. Electrical
2. Smoking
3. Friction

Some additional causes of fires include overheating, cutting and welding, chemical reactions, fuel sources, and mechanical sparks.

Types of Burns

Smoke inhalation is the leading cause of death in fires via asphyxiation and poisoning; however, burns are the most common injury. A **burn** is an injury that damages and destroys skin layers.

Types of burns include:

- Scalds
  - » The most common cause of burn injuries, these occur when skin comes into contact with hot liquids
- Thermal
  - » The next most common cause of burn injuries; common sources include careless smoking and improper use of flammable liquids
- Electrical
  - » Contact with live wires or unprotected electrical outlets
- Chemical
  - » Most often occur during industrial accidents involving common battery acids, oils, and gases

Burns vary in severity:

- **First-degree:** Inflammation or reddening of the skin
- **Second-degree:** Blistering of the skin
- **Third-degree:** Damage to the basal skin cells

B. ELEMENTS OF FIRE

Fire is a chemical reaction involving rapid oxidation or burning of a fuel. It needs four elements to occur. This is known as the fire tetrahedron:

Fuel

A fuel can be any combustible material in a solid, liquid, or gaseous state; most solids and liquids become a vapor or gas before they will burn.

Oxygen

The air we breathe is about 21 percent oxygen; fire only needs an atmosphere with 16 percent oxygen to support combustion.

Heat

Heat is the energy necessary to increase the temperature of the fuel to a point where sufficient vapors are given off for ignition to occur.

Chemical Reaction

A chain reaction can occur when the other three elements of fire are present in the proper conditions and proportions; fire occurs when this rapid oxidation, or burning, takes place.

C. CLASSES OF FIRE

Fires are classified according to the types of objects being burned:

Class A: Ordinary combustibles such as wood, paper, cloth, rubber, or certain types of plastic.

Class B: Flammable or combustible gases and liquids such as gasoline, kerosene, paint, paint

thinners, or propane.

Class C: Energized electrical equipment such as appliances, switches, or power tools.

Class D: Certain combustible metals such as magnesium, titanium, potassium, or sodium.

Class K: Combustible cooking oils and fats in commercial cooking equipment.

D. FIRE EXTINGUISHERS

Fire Extinguisher Types

Fire extinguishers will depict the class of fire they are designed to fight, often using symbols or pictograms on their respective labels.

Pressurized water fire extinguishers are used for Class A fires only. Pressurized water fire extinguishers work by cooling the burning materials to below the ignition point. They have a maximum effective range of 30 – 40 feet.

Carbon dioxide (CO_2) fire extinguishers are used for Class B and C fires. Carbon dioxide fire extinguishers work by removing oxygen from the fire tetrahedron. Their effectiveness decreases as the temperature of the burning material increases. They have a maximum effective range of 3 – 8 feet.

Multipurpose dry chemical fire extinguishers are used for Class A, B, and C fires. Multipurpose dry chemical fire extinguishers work by smothering the burning materials with a layer of fire-retardant powder. They have a maximum effective range of 5 – 20 feet.

Halon fire extinguishers are used for Class A, B, and C fires. However, production of halon fire extinguishers was halted in 1994 due to the ozone-depleting qualities of the chemical and are therefore unlikely to be used.

Combustible metal fire extinguishers are used for Class D fires only. Combustible metal fire extinguishers contain a pressurized dry powder that is designed specifically for smothering burning metals.

Wet chemical fire extinguishers are used for Class K fires. Wet chemical fire extinguishers work by cooling the fire and forming a foam blanket that prevents reignition. These fire extinguishers are needed due to the higher heating rates of cooking oils in commercial cooking appliances.

Using a Fire Extinguisher

The average fire extinguisher will only operate for about 30 seconds — there is no time to learn how to operate a fire extinguisher during an actual emergency!

Where an extinguisher has been provided for an employee, the employee must be provided training on:

- General principles of fire extinguisher use
- Hazards of incipient (beginning) stage firefighting

To properly use a fire extinguisher, follow **P.A.S.S.**:

- **P**ull the pin
- **A**im the hose at the base of the fire
- **S**queeze the trigger
- **S**weep slowly back and forth, covering the entire fire base with the substance

Fire extinguishers must be maintained in fully charged and operable condition at all times. They must be kept in designated places, with those areas clearly marked and accessible. Monthly inspections and annual maintenance checks must be completed and recorded. Records must be retained for one year after the last entry or for the life of the shell, whichever is less.

E. B.L.E.V.E.

B.L.E.V.E. is:

- **B**oiling
- **L**iquid
- **E**xpanding
- **V**apor
- **E**xplosion

When a container and its material are excessively heated, this may lead to a violent rupture, causing a rapid vaporization of the material. The possibility of B.L.E.V.E. increases with the volatility of the material and the condition of the container. Some warning signs that may indicate that a tank is about to fail are a large, intense jet stream-like flame or the sound of the tank expanding and contracting.

Extreme caution needs to be used if a fire occurs near containers that contain chemicals. If you are

not trained to handle B.L.E.V.E. hazards, evacuation is the best approach to dealing with a potential B.L.E.V.E situation.

In addition to the chemical hazard, the explosion of the tank from over-pressurization could send debris in all directions, potentially striking workers or property. If it is safe to do so and you have been appropriately trained in how to respond to B.L.E.V.E. hazards, tanks should be cooled immediately to prevent B.L.E.V.E. If the container is equipped with a relief valve, the relief valve should be allowed to vent.

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SECTION XIV: RESPIRATORY PROTECTION

When employees must work in environments with insufficient oxygen or where harmful dusts, fogs, smoke, mists, fumes, gases, vapors, or sprays are present, they need to utilize respiratory protection equipment.

Employees must wear respirators whenever engineering and work practice control measures are not adequate to prevent atmospheric contamination at the worksite.

A. RESPIRATORY PROTECTION REQUIREMENTS

The regulations pertaining to respirator use are contained in 29 CFR 1910.134 (OSHA) and 8 CCR 5144 (Cal/OSHA).

In order for an employee to be able to use a respirator, the employer needs to have a written respiratory program that includes:

- Worksite-specific procedures
  - » Developed to ensure each worksite has addressed unique respiratory protection hazards
- Program/hazard evaluation
  - » Ensures that the respiratory protection program is being properly implemented and employees are using respirators properly
- Training
  - » Must address hazards, selection, regulations, proper use, limitations, inspections, maintenance, annual fit tests, and training
- Medical evaluations
  - » Questionnaire, medical tests, physician approval — updated periodically
- Fit testing
  - » Chemical test of gas-tight fit, fit tests for APRs and SCBAs, qualitative vs. quantitative
- Selection and use
  - » Addresses hazards posed by respiratory protection — hazard control hierarchy
- Inspection and maintenance
  - » When and how to inspect respirators, storing, protection from damage, sanitizing, and decontamination

Fit Testing

Before an employee may be required to use any respirator with a negative- or positive-pressure tight-fitting facepiece, the employee must be fit tested with the same make, model, style, and size of respirator that will be used.

Qualitative fit testing is not an analytical measurement. This method of testing depends on the user's response to an aromatic odor. It is the less expensive method of testing.

Quantitative fit testing is conducted in a controlled environment. It compares outside contamination to the atmosphere inside the mask. This method is not dependent on the user and is more expensive.

Employees may require additional fit testing if:

- The employee reports changes in physical condition that could affect the fit of the respirator
- The physician or other licensed health care provider makes visual observations of a change in fit
- The employer, supervisor, or program administrator makes visual observations of a change in fit

B. AIR-PURIFYING RESPIRATORS (APRs)

Types of APRs

- Quarter-, half-, and full-face
- Dual-cartridge or single-canister
- Negative-pressure mask
- Powered air-purifying (PAPR)

APR Use

- Must have adequate oxygen to be used
- Cartridges must not exceed capacity
- Seal checks determine proper donning and must be verified every time

  - » Negative-pressure check
  - » Positive-pressure check

APR Limitations

- Oxygen-deficient atmosphere
- Cartridge capacity exceeded
- Poor warning properties
- Atmosphere not removed by cartridge
- IDLH atmosphere
- Rescue
- Unknown atmosphere

APR Cartridges

- Intended for single use only
- Use only fresh cartridges
  - » Factory-sealed bags only
  - » Once opened, cartridge begins absorbing
- Do not save and reuse
- Read the label (at least once)
- Color-coded by OSHA regulation
- Replace if breakthrough or resistance (load up) occurs

APR Maintenance

- Field decontamination
- Washing
- Sanitizing
- Package for storage

C. SELF-CONTAINED BREATHING APPARATUSES (SCBAs)

SCBA Components

- Backpack
- Air cylinder
- Regulator
- Facepiece

SCBA Use

- Oxygen-deficient atmosphere
- APR cartridge capacity exceeded
- Poor warning properties
- Atmosphere has not been removed by cartridge
- When APR use is prohibited
- Until ATM is assessed
- If limitations to APR use exist
- IDLH atmosphere
- Rescue
- Unknown atmosphere

SCBA Limitations

- Weight
- Time
- Mobility
- Body size and shape
- Range of motion
- Work output
- Heat stress

SCBA Modes

- Demand mode
  - » Old mode, has been prohibited since 1970s
  - » Protection factor = 50
- Positive-pressure mode
  - » All SCBAs should be in this mode
  - » Protection factor = 10,000

SCBA Safety

- Low-pressure alarm sounds at 20% of remaining air
- Buddy system
- Safety standby
- Integrity checks
- Communication
- Plan entry

SCBA Maintenance

- Inspect after each use
- Wash and sanitize
- Store to protect from damage

- Follow maintenance procedures
- Inspect SCBAs monthly
- Annual visual inspection
- Hydrostatic test

D. ASSIGNED PROTECTION FACTORS

Employers must use the assigned protection factors established by NIOSH to select a respirator [see "TABLE 1. Sample of the Assigned Protection Factors (APFs) Given to Certain Respirators" on page 54]. Always check the manufacturer's guidelines for specific assigned protective factors.

Employers must use the assigned protection factors listed in Table 1 to select a respirator that meets or exceeds the required level of employee protection. When using a combination respirator (e.g., airline respirators with an air-purifying filter), employers must ensure that the assigned protection factor is appropriate to the mode of operation in which the respirator is being used.

E. PROTECTION FROM WILDFIRE SMOKE

The California Wildfire Smoke Emergency Order is a recent emergency order set forth by the Cal/OSHA Standards Board stating that employers must take new action to protect workers in the field from wildland fire smoke exposure.

Current Air Quality Index (Current AQI) is the method used by U.S. EPA to report air quality on a real-time basis.

PM2.5 refers to solid particles and liquid droplets suspended in air, known as particulate matter, with an aerodynamic diameter of 2.5 micrometers or smaller. They can be inhaled into the deepest part of the lungs and may cause health concerns.

Some immediate health effects from inhaling wildfire smoke include:

- Runny nose
- Irritated sinuses
- Chest pain
- Headaches
- Asthma attacks
- Coughing
- Trouble breathing
- Stinging eyes
- Scratchy throat

Air Quality Index Ranges

"Unhealthy AQI" is measured from 151 to 200. In this range, everyone may experience some health effects, and sensitive groups may experience serious effects.

"Very unhealthy AQI" is measured from 201 to 300. In this range, everyone may experience serious health effects.

"Hazardous AQI" is greater than 300. This range exhibits emergency conditions, and the entire population is likely affected.

Employer's Duty to Workers

Employers must determine exposure to PM2.5 for worksites before each shift and periodically thereafter, as needed. Employers must reduce employee exposure to PM2.5 to less than a current AQI of 151 by:

- Providing enclosed buildings, structures, or vehicles where the air is filtered
- Relocating work to a location where the current AQI for PM2.5 is lower

TABLE 1. Sample of the Assigned Protection Factors (APFs) Given to Certain Respirators

TYPE OF RESPIRATOR	QUARTER-MASK	HALF-MASK	FULL-FACEPIECE	HELMET OR HOOD	LOOSE-FITTING FACEPIECE
Air-purifying respirator	5	10	50	.....	.....
Powered air-purifying respirator (PAPR)	.....	50	1,000	25/1,000	25
Supplied air respirator (SAR) or airline respirator					
• Demand mode	.....	10	50	.....	.....
• Continuous flow mode	.....	50	1,000	25/1,000	25
• Pressure demand or other positive-pressure mode	.....	50	1,000	.....	.....
Self-contained breathing apparatus (SCBA)					
• Demand mode	.....	10	50	50	.....
• Pressure demand or other positive-pressure mode (e.g., open/closed circuit)	.....	.....	10,000	10,000	.....

See 29 CFR 1910.134(d)(3)(i)(A) and 8 CCR 5144(d)(3)(A) for more information.

SECTION XV: AIR MONITORING

The data collected from air monitoring is critical to various phases of work remediation, including scene assessment, selection of personal protective measures, and the ability to re-enter evacuated areas. Therefore, knowledge of instrument capabilities, limitations, use, and maintenance is critical to ensuring that immediate air monitoring data may be provided when needed.

A. PURPOSE

Airborne contamination at worksites may present a significant risk to the health and safety of field personnel. Air monitoring provides critical information necessary for:

- Selecting PPE
- Specifying safe work practices
- Assessing the potential health effects of exposure
- Determining actions to mitigate the hazards
- Helping to determine work, decon, isolation, and evacuation areas
- Assessing efficiency of operations

B. PRINCIPLES OF DATA COLLECTION & MEASUREMENT

Methods

Field Monitoring: Sampling the air to obtain instantaneous results.

Air Sampling: Collecting air samples for laboratory analysis.

Requirements

- Select the appropriate instrument
- Consider the limitations of the instrument selected
- Use the instrument as specified by the manufacturer
- Use only properly calibrated instruments
- Take representative samples
- Consider any interferences, uncertainty, and the potential for error that may influence the results when making conclusions or interpretations

Data Types

Qualitative Data: Identify whether a hazard is present.

Quantitative Data: Specify the quantity or concentration.

Most field monitoring equipment provides both qualitative and semiquantitative data (**mixed data**). The data obtained by monitoring equipment can be characterized as follows:

- Accuracy: How close measured results are to actual conditions
- Precision: How close repeated measurements are to each other
- Representative: Whether sample results accurately characterize conditions
- Error: Conditions that can affect accuracy and/or precision

Equipment Characteristics

Careful consideration should be made with regard to the characteristics and capabilities of air monitoring instruments. Based on task requirements and conditions, assess the equipment for:

- Portability: Rugged or lightweight
- Useful results: Response time; direct, easy readings
- Selectivity: The ability to identify specific contaminants
- Sensitivity: The lowest concentration detectable
- Specification: Instrument use in hazardous environments (e.g., flammable)

Equipment is built to the standards established by the National Fire Protection Association (NFPA) and published in the National Electrical Code (NEC).

Hazards are commonly encountered when performing field monitoring operations. There are four basic kinds of atmospheric hazards:

- Oxygen
  - » Deficiency and enrichment
  - » Percentage of oxygen in the air
- Flammable gases and vapors
  - » Percentage of the lower explosive limit (LEL) of a vapor or gas in air
- Toxic contaminants
  - » Concentration (ppm or mg/m^3) of toxic vapor
- Radioactive hazards

C. INSTRUMENTATION PROGRAM

Selection

- Type of monitoring
- Continuous versus periodic

Field Applications

- Site survey
- Hazard identification and evaluation
- Operations monitoring

Maintenance

- Clean case, exterior, and accessories after each use
- Check alarm and meter after each use
- Check battery after each use
- Check general instrument operation after each use
- Replace hoses, filters, and sensors as needed
- Perform periodic manufacturer checkup (cleaning, inspection, calibration, etc.)
- Document all repair and maintenance work
- Store in a clean, dry, indoor, temperature-regulated environment

Functionality Assessment

Calibration: Sampling a known concentration of a chemical and comparing the expected values to the instrument readings. Instrument calibration helps to check instrument precision and accuracy so that the instrument can be adjusted if needed.

Bump Test: Brief exposure of the monitor to gas in order to verify that the sensors respond and the instrument alarms function properly.

If an instrument fails a bump test or a calibration check, the operator should perform a full calibration on it before using it. If the instrument fails the full calibration, the employer should remove it from service.

Field Use

Consider the following prior to using instruments in the field:

- All operators must be trained
- Instruments must be protected from damage, contamination, etc.
- Instruments must be warmed up and/or checked before use
- Instruments should be cleaned in the field after each use
- Instrument sensors must never be saturated

SECTION XVI: SAMPLING METHODS & PROCEDURES

Sampling provides critical information about the environment in which employees will be working. Sampling helps to determine what type of PPE will have to be worn while working in that type of environment.

Sampling also helps to establish appropriate work zones and provides analytical data that is necessary for staying in compliance with pertinent regulations. In order to obtain the required information, the correct type of sampling needs to be performed.

A. PURPOSE & OBJECTIVES

Representativeness: The sample needs to be chosen so that it possesses the same qualities or properties as the parent materials.

Sample Size: The size of the sample must be carefully chosen with respect to the physical properties of the entire object.

Sample Integrity: The sample must retain the properties of the parent from sampling through analysis.

Method Selection Criteria

- Practicality
  - » Proven procedures capable of being used or easily adapted
- Representative
  - » Delivering a true representation of the situation under investigation
- Economics
  - » Cost of the equipment or manpower
- Simplicity
  - » Ease of operation
- Compatibility
  - » Keep in mind the possibility of error
- Versatility
  - » Be adaptable to a variety of situations
- Safety
  - » Risk to personnel

Sample Types

- Air
- Environmental
- Hazardous/concentrated
- Ground water
- Surface water
- Container of unknown liquids
- Soil and sediment sample
- Solid waste
- Surface wipes

B. SAMPLING STRATEGIES

Sampling strategies help to ensure that enough information is gathered from a location to be able to provide the best protection for workers as well as getting the appropriate information to assist in cleanup efforts.

Biased Sampling: Sampling obvious areas of contamination.

Unbiased Sampling: Sampling the whole area.

Systematic Sampling: Sampling every gridline intersection.

Random Sampling: Sampling from randomly chosen grid intersections.

Grab Samples: Discrete samples from a single location.

Composite Samples: Samples taken from several locations and combined before analysis.

Background Samples: Samples collected to establish the natural concentration of constituents in the local environment prior to the induction of potential contamination.

C. SAMPLING CONTROLS

Sampling controls help to maintain quality assurance and quality control among the different samples that will be obtained at a location and to determine a lab's performance in the analytical testing process. Here are a some types of sample

controls:

Trip Blanks (TBs): Prepared to determine if any contamination occurred during transport of the sample containers and samples.

Field Duplicates (FDs): Collected in the field to identify field contamination.

Field Spikes (FSs): A known sample is sent with the sample and the lab results are compared.

Split Samples (SSs): Samples are split and sent to different labs.

D. CHAIN OF CUSTODY

A chain of custody (COC) traces the path of the sample and is an essential document to the sampling process.

COC records must contain the following data:

- Sample numbers
- Location of sample
- Dates and times of sampling
- Number of sampling containers
- Types of sampling containers and preservatives
- Sample matrix
- Signatures of samplers
- Signatures and dates of custody transferors and transferees

SECTION XVII: FIELD OPERATIONS & CHEMICAL HANDLING

Field operations help to assess site characteristics that will guide the establishment of priorities for chemical handling and indicate areas for chemical, equipment, and personnel staging as well as sampling areas and locations for the transportation of the hazardous waste to and from the site.

A. PURPOSE & CONSIDERATIONS

Working with or around chemicals is a part of many employees' job functions. Employees may handle chemcials when responding to safety issues, orienting for sampling, and/or organizing locations for storage/disposal.

First, assess the purpose of handling:

- Responding to safety issues
- Orienting for sampling
- Organizing for storage/disposal

All considerations need to be taken into account before handling chemicals, including:

- Necessity of movement vs. health risks
- Newly discovered hazards
- Spill/release containment

Before moving containers, there must be an established guideline or standard operating procedure for safe chemical and container handling.

Some things to remember about moving containers:

- Move small containers first
- Use extreme caution with damaged/leaking containers
- Use proper lifting/moving techniques
- Always plan for the worst
  - » Wear the appropriate PPE

B. DRUM & CONTAINER HANDLING

All hazardous substances, soils, liquids, residues, etc. must be transported, labeled, and disposed of in accordance with DOT, OSHA, and U.S. EPA regulations. Additionally, all drums and containers used for these purposes must meet the same regulations and must be inspected, and their integrity assured, prior to being moved.

Employees exposed to transfer operations involving drums or containers must be warned of the potential hazards associated with the materials. Unlabeled drums and containers must be assumed to contain hazardous substances.

In general, site operations must prioritize the minimization of drum movement. Drums and containers that cannot be moved without failure must be emptied via appropriate methods.

Opening Drums & Containers

When opening drums and containers, use the following procedures:

- Airline respirator systems must be connected and protected from contamination and physical hazards
- Employees not involved in operations must be kept at a safe distance
- Do not stand on drums or containers
- Drums and containers must be opened in such a manner as to safely relieve pressure (preferably from a remote location)
- Fire suppression, drum opening, and monitoring equipment must be located behind the blast shield
- Employees working near drums or containers being opened must be provided a suitable protection shield
- In potentially flammable atmospheres, non-sparking material-handling equipment and hand tools must be used

Over time there can be changes in container integrity and/or chemical properties, and this will make moving or handling chemicals and containers more hazardous. Particular focus must be given to specialized risks that could be present.

Explosive and/or shock-sensitive chemicals can develop over time as substances dry out, degrade, or mix with other materials. If you suspect this has happened:

- Seek specialized assistance
- Use isolation
- Limit personnel
- Consider evacuation

Pressurized drums can also pose a risk. These drums must be handled with extreme caution. If the pressure of a container needs to be released, there are certain steps that can be followed:

- Cool container
- Apply a one-quarter turn to the bung to slowly release the pressure
- Use remote de-pressuring devices
- Use non-sparking tools to assist with releasing the pressure

Drum Stinging & Bulking

Similar wastes are often mixed together and placed in bulk containers such as tanks or vacuum trucks for shipment to TSDFs. In order to do this, the compatibility of the waste with the equipment being used must be confirmed. Additionally, the equipment and connections must be inspected.

Use care with hoses that may contain waste, and use proper procedures to reduce clogging. Employees should be prepared for incidental spills or releases. Ensure that the vacuum truck exhaust port is pointed downwind. Hoses and equipment must be protected from vehicle and foot traffic, and all sources of ignition must be eliminated.

Hazards associated with stinging and bulking:

- Vapors in containers and vacuum trucks may present an inhalation hazard
- Flammable vapors in containers and vacuum trucks may be explosive or present a fire hazard
- Clogged hoses or fittings
- Leakage
- Static electricity

Plug & Dike Repair Kits

Leaking or otherwise deteriorated containers are extremely problematic for proper field operations. When faced with a leaking, open, and/or deteriorated container, consider overpacks or transferring the contents. Vapor releases must be assessed with respiratory protection and often require specialized assistance.

Plug & dike repair kits are used for mitigation of leaks. They are a temporary measure only. Limitations include:

- Requiring immediate implementation to be effective
- Compatibility issues
- Potential for small leaks to occur
- Not generally suitable for highway transportation

C. STAGING

The staging of chemicals is critical. Chemicals must be staged so that they will not release their contents. Chemicals need to be stored in compatible groups (i.e., with other compatible chemicals). They also need to be placed in an area that will reduce contamination in case a container fails. Staging areas must be have adequate access and egress routes.

Container staging aids in the organization and accessibility of containers. Staging areas will depend on the site, quantity and variety, hazards, and level of environmental protection.

Proper staging measures include:

- Store containers two-wide and in two rows
- Do not stack containers
- Ensure adequate width between the rows for entry and exit of personnel
- Place non-skid surfaces between rows
- Implement plastic sheeting to prevent contamination to the environment, or place containers into a sufficient secondary containment area
- Have spill kits near the staging area to address any spills that may occur

D. HAZARDOUS MATERIAL REGULATION & TRANSPORTATION

All containers need to be appropriately marked with the correct information according to U.S. EPA and other agencies' regulations. The handling, storing, and transportation of materials may require certain documentation under U.S. EPA's hazardous materials and hazardous waste regulations.

Generators of hazardous materials/waste must have an EPA ID number prior to transportation. A client may also have an EPA ID number. Numbers are issued by either U.S. EPA or DTSC.

Shipping Papers

Shipping papers name the generator/transporter/receiver and identify and describe the material or waste that is being shipped. One such paper is the bill of lading, which is used to ship hazardous materials.

The Uniform Hazardous Waste Manifest is used to ship hazardous waste. This paper identifies the waste and the generator and tracks the movement of the waste from its generation point to its eventual disposal or reuse (from "cradle to grave").

Labeling

Each shipment of hazardous materials must have shipping papers with the generator's name, EPA ID number, materials, hazard class, UN or NA number, packing group, quantity, and emergency response phone number. Containers must be properly marked and labeled for shipment.

Emergency response information useful in mitigating a spill must accompany each hazardous material transported.

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ADDITIONAL RESOURCES

ACRONYMS

ACGIH: American Conference of Governmental Industrial Hygienists

AIHA: American Industrial Hygiene Association

ANSI: American National Standards Institute

APF: Assigned protection factor

APR: Air-purifying respirator

AQMD: Air Quality Management District

ARC: American Red Cross

"C"/Ceil: Ceiling limit

CAA: Clean Air Act

CA DFW: California Department of Fish and Wildlife

CalEPA: California Environmental Protection Agency

Cal/OSHA: California Division of Occupational Safety and Health

Caltrans: California Department of Transportation

CAMEO: Computer-Aided Management of Emergency Operations

CAS: Chemical abstracts service

CCR: California Code of Regulations

CDC: Centers for Disease Control and Prevention

CERCLA: Comprehensive Environmental Response, Compensation, and Liability Act

CFR: Code of Federal Regulations

CGI: Combustible gas indicator

CHEMTREC: Chemical Transportation Emergency Center

CPC: Chemical protective clothing

CUPA: Certified Unified Program Agency

CVC: California Vehicle Code

CWA: Clean Water Act

Decon: Decontamination

DOT: Department of Transportation

DTSC: Department of Toxic Substances Control

EPCRA: Emergency Planning and Community Right-to-Know Act

ERG: Emergency Response Guidebook

FEMA: Federal Emergency Management Agency

FIFRA: Federal Insecticide, Fungicide, and Rodenticide Act

FM: Factory mutual

FRA: Federal Railroad Administration

GC: Gas chromatography

GPR: Ground-penetrating radar

Hazmat: Hazardous material

HAZWOPER: Hazardous waste operations and emergency response

HEPA: High-efficiency particulate air

HMIS®: Hazardous Materials Identification System

HMTA: Hazardous Materials Transportation Act

HSC: California Health and Safety Code

IC: Incident Commander

ICS: Incident Command System

IDLH: Immediately Dangerous to Life or Health

LC_{50}: Lethal concentration 50%

LD_{50}: Lethal dose 50%

LEL: Lower explosive limit

LFL: Lower flammable limit

mg/kg: Milligrams per kilogram

mg/m^3: Milligrams per cubic meter

MSA: Mine safety appliances

MSHA: Mine Safety Health Administration

MUC: Maximum use concentration

NFPA: National Fire Protection Association

NIOSH: National Institute for Occupational Safety and Health

NOAA: National Oceanic and Atmospheric Administration

NPL: National Priorities List

NRA: National Regulatory Agency

NRC: National Response Center

OES: Office of Emergency Services (California Governor's Office)

OSHA: Occupational Safety and Health Administration

OSPR: Office of Spill Prevention and Response

OV/AG: Organic vapor / acid gas (cartridge)

PAPR: Powered air-purifying respirator

PEL: Permissible exposure limit (OSHA and Cal/OSHA)

PF: Protection factor

PIO: Public information officer

PPB: Parts per billion

PPE: Personal protective equipment

PPM: Parts per million

PPT: Parts per trillion

PVC: Polyvinyl chloride

RCRA: Resource Conservation and Recovery Act

REL: Recommended exposure limit (NIOSH)

RWQCB: Regional Water Quality Control Board

SAR: Supplied-air respirator

SARA: Superfund Amendments and Reauthorization Act (1986)

SCBA: Self-contained breathing apparatus

SDS: Safety Data Sheet

SEMS: Standardized Emergency Management System

SIC: Standard industry code

SOP: Standard operating procedure

STEL: Short-term exposure limit

STLC: Soluble threshold limit concentration

SWQCB: State Water Quality Control Board

TCLP: Toxicity Characteristics Leaching Procedure

TLV: Threshold limit value

TSCA: Toxic Substances Control Act

TSDF: Treatment, storage, and disposal facility

TTLC: Total threshold limit concentration

TWA: Time-weighted average

UEL: Upper explosive limit

UFL: Upper flammable limit

UL: Underwriters laboratories

USCG: United States Coast Guard

USDA: United States Department of Agriculture

U.S. EPA: United States Environmental Protection Agency

USFS: United States Forest Service

WET: Wet Extraction Test (California)