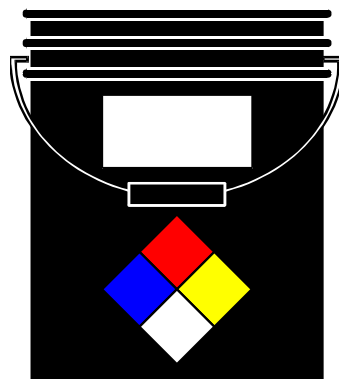


Health and Safety Training for . . .

Treatment

Storage and

Disposal Facility Workers



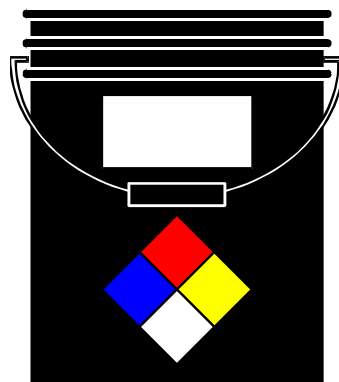
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Labor Occupational Health Program
University of California, Berkeley**

Health and Safety Training for . . .

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Storage and

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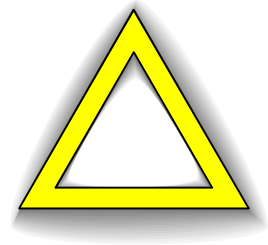


**Western Region Universities Consortium (WRUC)
Labor Occupational Health Program
University of California, Berkeley**

July 2007. Produced by the Labor Occupational Health Program (LOHP), University of California, Berkeley, for the Western Region Universities Consortium (WRUC). Funded by the National Institute of Environmental Health Science (NIEHS).

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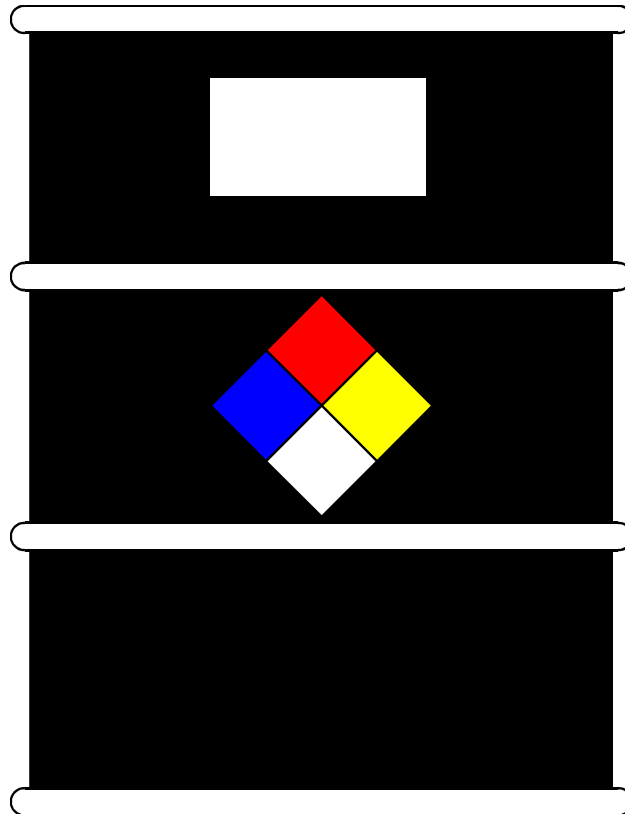


Contents

1. What Is Hazardous Waste?
2. Understanding Hazardous Waste Regulations
3. How Chemicals Can Harm You
4. Sources of Information: MSDSs and More . . .
5. Hazard Evaluation and Control
6. Medical Surveillance
7. Working Safely in Confined Spaces
8. Noise: Health Effects and Controls
9. Handling Drums and Hazardous Waste Samples
10. Ergonomics
11. Respiratory Protection
12. Chemical Protective Clothing
13. Fire and Incompatibles
14. Workers' Rights
15. Emergency Response and Planning
16. Strategies to Improve Health and Safety Back on the Job



What Is Hazardous Waste?



Outline

1. Hazardous Substances
2. Components That Define Hazardous Waste
 - Toxic
 - Reactive
 - Ignitable
 - Corrosive
 - Persistent and Bioaccumulative
 - Examples of Hazardous Wastes Generated by Various Businesses and Industries
 - Prioritizing Chemical Hazards at Work

Objectives

Participants will be able to:

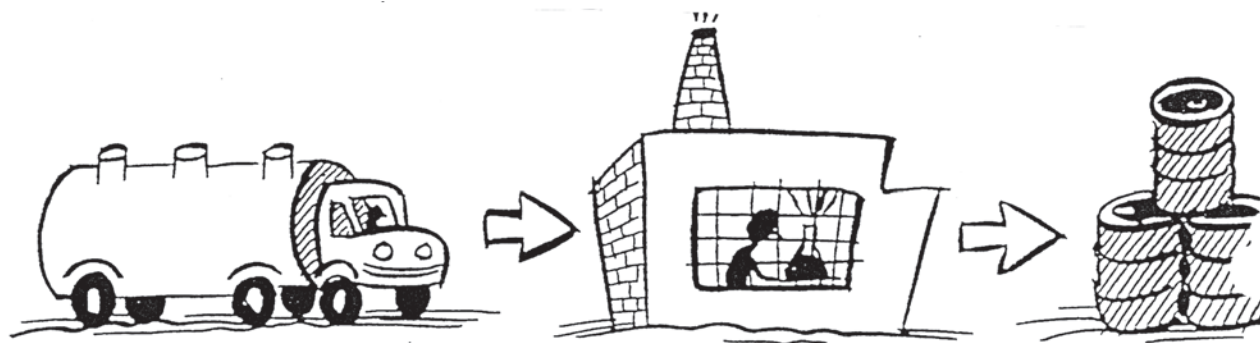
1. Define the term “hazardous waste” according to the California Health and Safety Code.
2. Classify different types of hazardous wastes based on five characteristics: toxic, reactive, ignitable, corrosive, persistent, and bioaccumulative.
3. Analyze a worksite and identify hazards to which workers may be exposed.

Hazardous Substances

Hazardous substance is a generic term used to describe hazardous materials, hazardous chemicals, and hazardous waste. The following chart gives a brief overview of regulatory agencies and requirements that govern these three categories of hazardous substances.

Hazardous Substances

Coverage	Hazardous Materials	Hazardous Chemicals	Hazardous Waste
Source of Regulations	DOT49 CFR	OSHA29 CFR	EPA & DOT40 & 49 CFR
Hazard Classes	23 Hazard Classes	16 Hazard Classes	5 Hazard Classes
Required Information	Shipping Papers Labels/Markings Identification Placarding	Right-To-Know Hazard Communication MSDS Label/Markings	Listed Waste Characteristics H.W. Manifest Markings
Jurisdictions	Transportation	In-Plant Use	Disposal



Definition of Hazardous Waste: Any solid, liquid, or contained gaseous material for disposal or recycle that poses significant potential harm to human health or environmental quality (from RCRA, 1976; see also California Health and Safety Code sections 25117 and 25122).

A waste is hazardous if it:

1. Is listed as such by a regulatory agency (EPA in 40 CFR 261 or Cal-EPA, Department of Toxic Substance Control (DTSC) in Title 26 Calif. Code of Regulations, section 22-66680). DTSC can be more stringent than the federal regulations in characterizing hazardous waste.
2. Has one or more of the following characteristics:
 - a. **toxic** is poisonous (e.g., heavy metal, pesticides, etc.)
 - b. **reactive** unstable, may react with water air or other chemicals (e.g., wastes containing cyanides or chlorine; etc.)
 - c. **ignitable** easily combustible or flammable (e.g., paint wastes, solvents)
 - d. **corrosive** dissolves metal, other materials, or burns skin (e.g., acids, caustics)
 - e. **persistent and bioaccumulative** metals and chemicals that do not break down when released into the environment (such metals and chemicals as: Cadmium, Lead, DDT, Dioxins, PBB's, PCB's).

Generators of waste must determine if the waste is “hazardous” according to the criteria above.

Components That Define Hazardous Waste

Toxicity

Toxicity is defined as the ability of a chemical or other substance to harm you when you touch, breathe, or swallow it. This term also refers to substances that affect systems and/or organs in a body. A material's toxicity usually depends on the dose of the substance.

Examples of Toxic Wastes

Following is the Toxicity Characteristics Leaching Procedure (TCLP):

1. Runoff from irrigation may carry toxic or poisonous substances that can harm living systems. The following pesticides can damage nerve cells (they are called neurotoxins):

- DDT
- Chlordane
- Malathion
- Parathion
- Dibromochloropropane (DBCP, now banned in the United States)

2. Chemical wastes from industrial operations contain many different toxic substances.

3. Many heavy metals used in industrial processes are toxic and very persistent in the environment.

For example:

- Lead (a neurotoxin, damages the nervous system)
- Chromium (a carcinogen, causes cancer)
- Mercury (a neurotoxin, damages the nervous system)



Reactive Wastes

1. These involve an unstable chemical that reacts with water, air or other chemicals to ignite, produce heat or release hydrogen or oxygen that enhance combustion.
2. Some reactive chemicals, called pyrophoric, are capable of self-ignition.
3. Other reactive chemicals, while not self-igniting (under normal conditions), can still react to produce heat, which can make it easier to ignite other combustibles in a waste mixture.
4. Title 26 Toxics Section 22-66680 (California Code of Regulations) has reactivity criteria under which various substances are classified.



undergo sudden
violent change



react violently
with water



form a toxic gas when
mixed with water

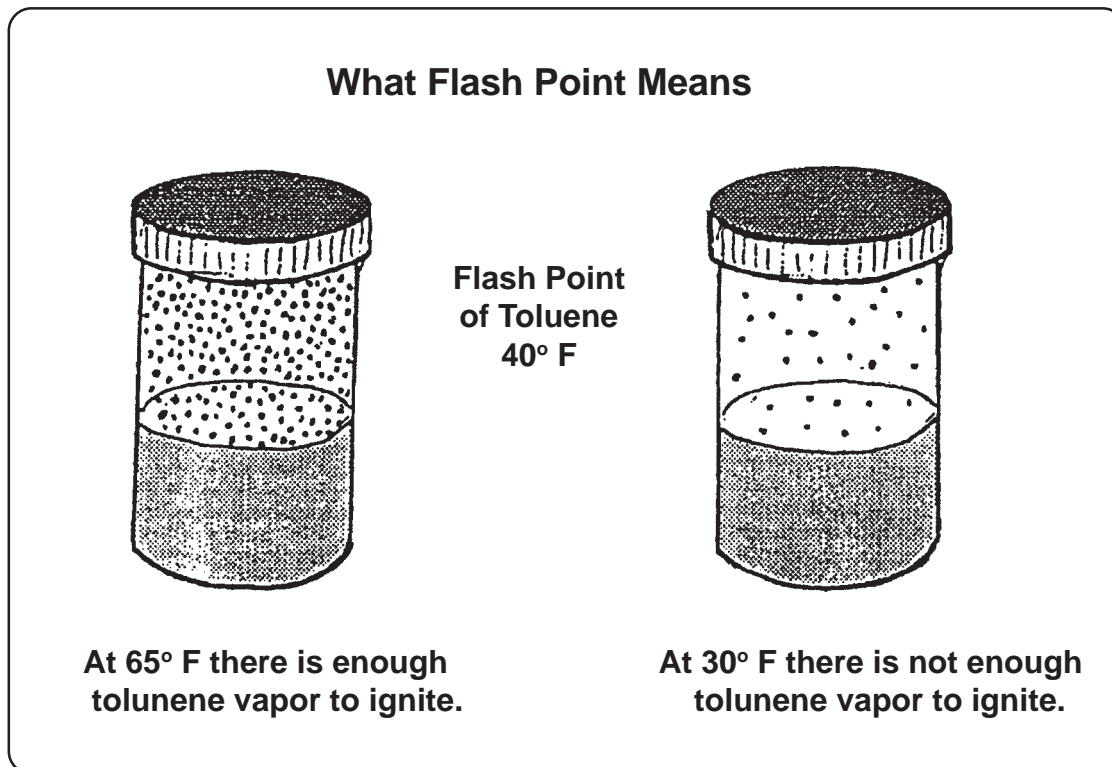
Examples of Reactive Substances

1. Caustic soda (sodium hydroxide or “lye”), potassium hydroxide and water react to produce intense heat.
2. Carbides (sodium and potassium carbide) and water react to produce heat and flammable gases.
3. Calcium oxide (quicklime) and water react to produce heat (can ignite paper or wood).
4. Concentrated solution of hydrochloric (hydrogen chloride) and some common metals react to produce flammable hydrogen gas.
5. Hydrofluoric acid and some metals react to produce toxic hydrogen gas.

6. Concentrated solution of nitric acid and metal powders and/or turpentine (mineral spirits) react to produce an explosion.
7. Cyanide salts and water and/or acid react to produce toxic and flammable hydrogen cyanide gas.

Ignitable Wastes

1. Ignitability is measured in terms of the lowest temperature (or energy) required for a material to ignite. This temperature required for a material to ignite is called the flashpoint of that material.
2. Flammability is the ability to initiate self-sustained combustion.
3. Combustibility is the ability to burn once ignited.
4. According to the U.S. Environmental Protection Agency (EPA), highly ignitable materials have flashpoints of less than 140° F.



**EPA defines a Flammable Waste as
any waste with a flashpoint less than 140°**

Examples of Ignitable Hazardous Wastes

A. Paint Sludge and Spent Organic Chemicals Generated by:

1. Commercial painting
2. Paint manufacturing
3. Auto body shops

B. Solvents

Examples: Alcohols, acetones, methyl ethyl ketones, petroleum-based solvents

C. Flammable and Combustible Dusts

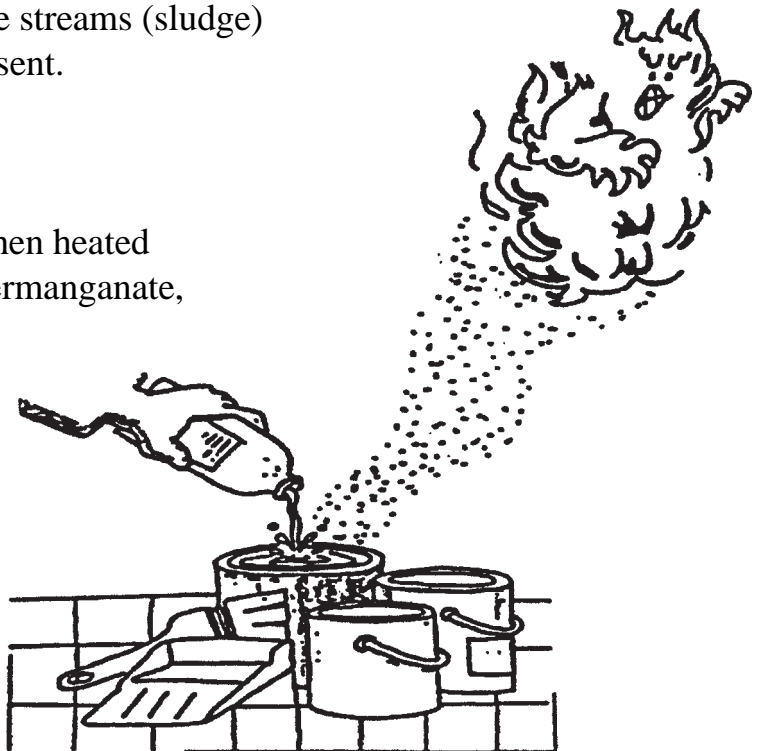
Examples: Agricultural dusts, particulates, metal dusts, plastic dusts, wood dusts.(Note: Ignition is possible only with high airborne concentrations.)

D. Chemical Wastes

1. Most organic chemicals are ignitable and will readily burn.
2. Organic chemicals present in waste streams (sludge) may ignite if ignition source is present.

E. Oxidizers

1. Chemicals that produce oxygen when heated (e.g., nitric acid, chromic acid, permanganate, peroxide).
2. Oxidizers can increase ignitability of combustible materials.



Corrosive Wastes

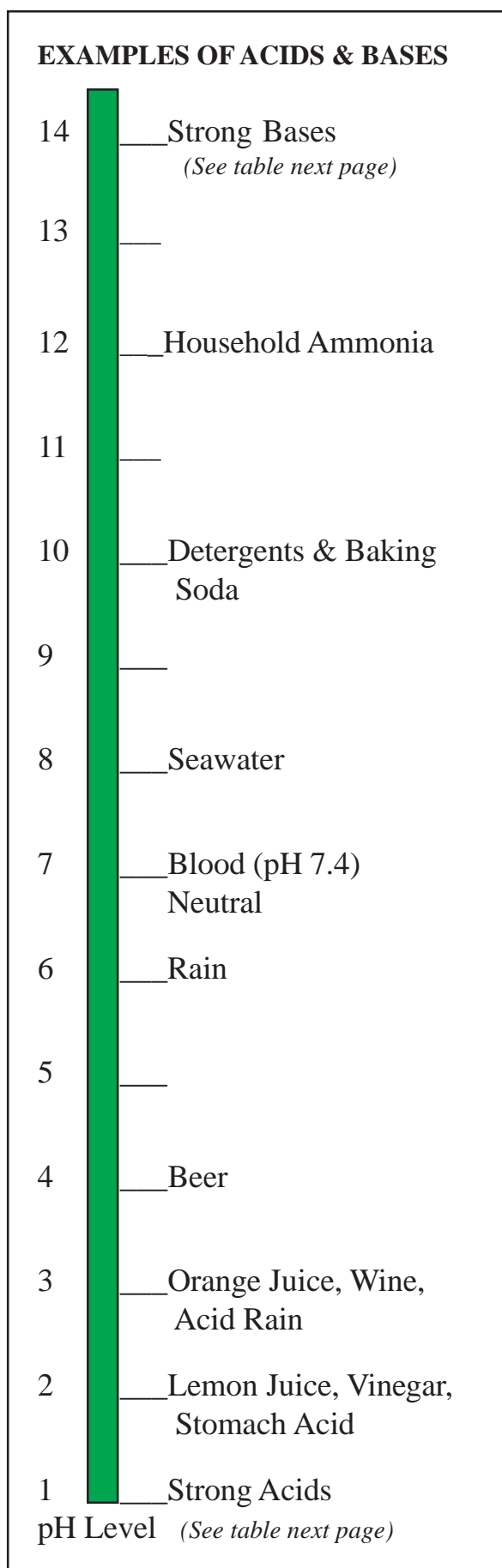
A corrosive is a chemical that causes visible destruction of, or permanent changes in, living tissue at the site of contact. Many hazardous wastes are corrosive. Most corrosives turn out to be acids or bases. (Bases are sometimes called caustics.)

The pH scale is a simple way to define acids and bases. This scale assigns a number from 0 to 14 to a solution.

Any solution with a pH less than 7 is an acid.
Any substance with a pH greater than 7 is a base. A solution with a pH of 7 is neutral.

The solutions with very low and very high pHs are dangerous. EPA defines any solution with a pH less than 2 or greater than 12½ as a corrosive. If these materials contact your skin they will cause severe chemical burns. The longer the contact time the greater the damage that will occur. The corrosiveness of an acidic or basic solution depends upon its concentration. Solutions that are diluted with a large amount of water may not be corrosive. Concentrated solutions are the most dangerous.

Source: The New England Consortium, *Basic Health and Safety Course for Hazardous Waste Site Personnel*, 1997.



Examples of Acids and Bases

A. Strong Acids

- Sulfuric Acid
- Nitric Acid
- Hydrochloric Acid
- Hydrofluoric Acid

B. Strong Bases

- Sodium Hydroxide (lye, caustic soda)
- Potassium Hydroxide (caustic potash)

Persistent and Bioaccumulative Waste

1. A waste is persistent if it does not biodegrade or break down easily in the environment.
2. A waste is considered bioaccumulative if it accumulates or builds up in living things.
3. Lists of persistent and bioaccumulative substances are found in Title 26 California Code of Regulations (CCR) section 22-66699.

Examples of Persistent or Bioaccumulative Substances

1. Lead, lead compounds
2. Chromium, chromium compounds
3. DDT, DDE, DDD
4. Heptachlor
5. Chlordane
6. PCBs (Polychlorobiphenyls)
7. 2,4,5-T (2,4,5 - Trichlorophenoxyacetic Acid)
8. Dioxin
9. Trichloro Ethylene
10. Asbestos (Friable)



Examples of Hazardous Wastes Generated by Various Businesses and Industries

Waste Generators

Waste Type

Chemical Manufacturers

- Strong Acids and Bases
- Spent Solvents, Cyanides, Ignitables
- Reactive Wastes

Automobile Maintenance/Repair Shops

- Heavy Metal Paint Wastes
- Ignitable Wastes
- Used Lead Acid Batteries
- Spent Solvents

Photo Processing/Printing Industry

- Heavy Metal Solutions, Organic Chemical
- Ink Wastes, Cyanide
- Spent Solvents, Ammonium, Nitrate
- Liquids
- Ink Sludges/Containing Heavy Metals

Leather Products Manufacturing

- Waste Toluene and Benzene

Paper Industry

- Paint Wastes Containing
- Heavy Metals
- Ignitable Solvents
- Strong Acids and Bases

Construction Industry

- Ignitable Paint Wastes, Asbestos
- Spent Solvents, Lead
- Strong Acids and Bases

Cleaning Agents and Cosmetics
Manufacturing

- Heavy Metal Dusts
- Ignitable Wastes
- Flammable Solvents
- Strong Acids and Bases

Furniture and Wood Manufacturing
and Refinishing

- Ignitable Wastes, Resin
- Spent Solvents, Adhesives

Metal Manufacturing

- Paint Wastes Containing Heavy Metals
- Strong Acids and Bases
- Cyanide Wastes
- Sludges Containing Heavy Metals

Summary: Prioritizing Chemical Hazards at Work

Asking a series of questions can help you prioritize chemical hazards. The two major types of questions that need to be answered to establish technical toxic priorities are:

1. How serious is the hazard?

- Is the chemical toxic? What can it do to the body?
- Is there any exposure occurring? How much?
- Is it a cancer causing chemical?
- Does it cause reproductive reactions?
- Can it cause allergic reactions?
- Can it cause eye, nose, throat, skin or lung corrosion or burns for those exposed to a moderate level of the chemical?
- Does the chemical have few or no warning properties?

2. What is the level of exposure?

- Is there *known and extensive* contact or exposure for at least one hour a day?
- Is there some contact for at least half a day?
- Is there a potential for a sudden exposure to high levels (accidental release)?

As a practical guide, first look at the answers to the above questions for each hazardous substance at your plant or on each site. Which exposures occur with the highly toxic chemicals/substances, and which exposures affect the most workers? These are the priority exposures that need to be reduced or eliminated. Prioritizing decisions are tough choices for workers to make.

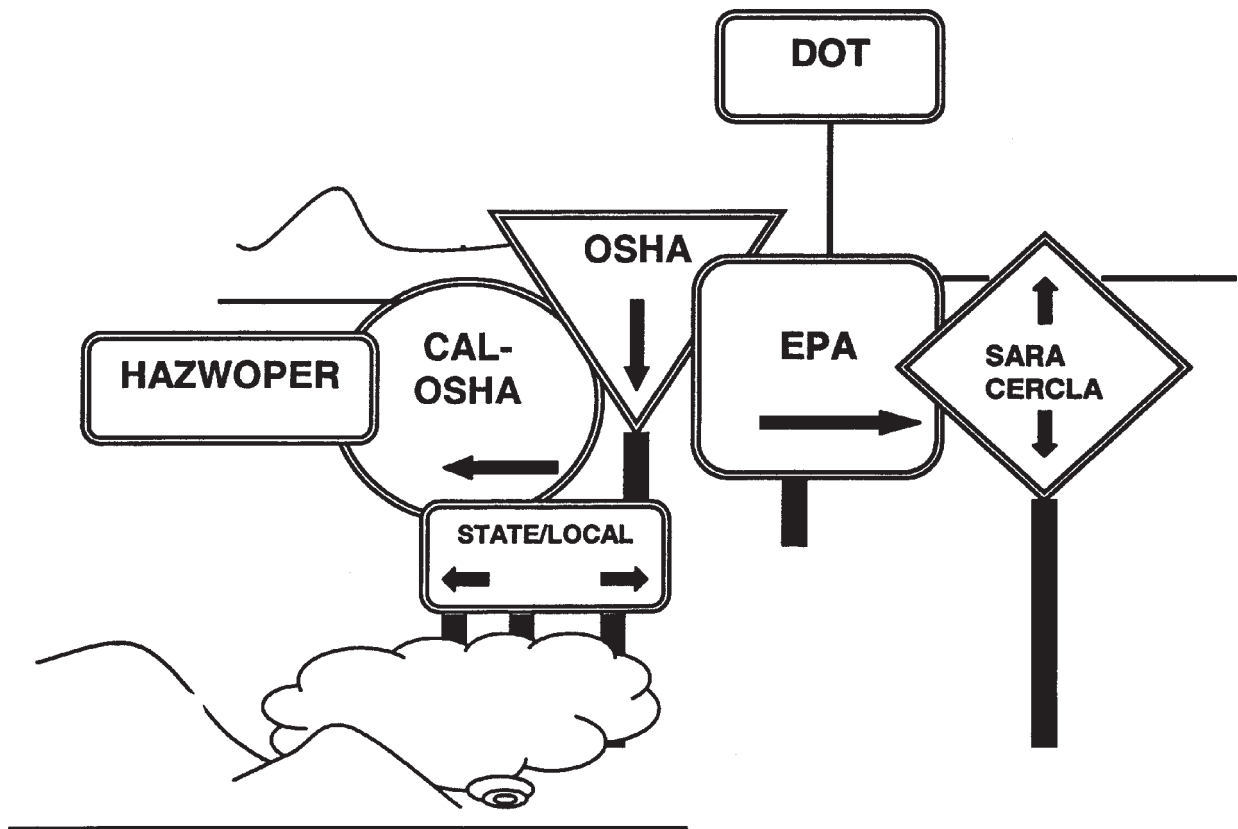
Going to fellow workers for advice and input will help in prioritizing health and safety problems. Working with your union health and safety committee, if you have one, is important as well. Recognizing what areas the company will improve, and how quickly changes can be made is also a factor to consider.

Beginning the process of prioritizing problems can feel overwhelming at times. Asking a series of questions, and combining that with your own training and experience can help simplify the process.

Thanks to the Oil, Chemical and Atomic Workers (OCAW) Union, and the American Federation of Grain Workers (AFGW) Union for permission to use questions and text from their publication in this exercise.



Understanding Hazardous Waste Regulations



Outline

1. Key Agencies Which Have Authority at Treatment, Storage & Disposal Facilities or Fixed Facilities
2. Evolution of Hazardous Waste Laws:
 - RCRA: Resource Conservation & Recovery Act
 - Superfund #1: CERCLA
 - Superfund #2: Superfund Amendments and Reauthorization (SARA)
3. Hazardous Waste Operations and Emergency Response Standard: HAZWOPER (OSHA 1910.120) (Cal/OSHA 5192)
 - Who is covered?
 - Training requirements
 - TSD facility requirements
4. How To Read a Cal/OSHA Standard
5. HAZWOPER Table of Contents

Objectives

Participants will be able to:

1. Recognize the extent of the hazardous waste problem.
2. Describe the major hazardous waste laws and determine which regulations apply to their workplace.
3. Identify the employer requirements and worker's rights under the OSHA hazardous waste standard (Cal OSHA GISO 5192).

Key Regulatory Agencies

Environmental Protection Agency (EPA)

1. Established in 1970 under National Environmental Policy Act (NEPA)
2. Responsibilities include:
 - implementation and enforcement of federal environmental laws (through regional offices) such as the NEPA, Clean Air Act, Clean Water Act, Superfund, RCRA, Hazardous Material Transport Act, Toxic Substances Control Act, FIFRA (pesticide regulation);
 - risk assessment and other environmental, toxicological research on environmental chemicals;
 - development of standards for hazardous substance use, transport, storage, and disposal, as well as for industrial pollution control; and
 - initiation and management of hazardous waste cleanups and certification/ approval of state Treatment, Storage and Disposal Facility (TSDF) permitting programs.

Cal/EPA

Cal/EPA is the California equivalent to the federal EPA. Prior to 1991, it was known as the Toxic Substances Control Division located within the California Department of Health Services. Responsibilities include:

- adoption and enforcement of standards and regulations for handling, processing, using, storing and disposing of hazardous wastes;
- enforcement of environmental laws for EPA;
- enforcement of California laws, which are often stronger and more protective of the environment than federal laws; and
- working with other state, regional and local agencies in hazardous waste site cleanup operations.

CUPA—Certified Unified Program Agencies

- Authorized by 1993 legislation
- “To establish a unified hazardous waste and hazardous materials management program and delegate enforcement authority from state agencies to local CUPA’s.”
- Local CUPA oversight areas include:
 - Hazardous waste generators
 - Treaters of hazardous waste subject to tiered permitting
 - Facilities with underground and above-ground storage tanks
 - Risk management and prevention plans
 - Hazardous materials management plans and inventory statements required by Uniform Fire Code.
- CUPA Program Objective: to consolidate administration, permitting, inspection, enforcement, and fee assessment functions of the above programs.
- Cal/EPA currently doing accelerated approval process; much of state is subject to CUPA jurisdiction.
 - One third of certified CUPA’s are cities or multi-city agencies.
 - Bay Area CUPA’s include:
 - Counties: Alameda, Contra Costa, Napa, San Francisco, Sonoma
 - Cities: Berkeley, Fremont, Hayward, Oakland, Newark, San Leandro, Petaluma

Occupational Safety and Health Administration (OSHA)

OSHA was established in 1970 to carry out the Occupational Safety and Health Act. OSHA is responsible for regulating workplace hazards and protecting workers.

OSHA:

- requires employers to provide a workplace without known health and safety hazards;

- sets standards to protect workers, and inspects workplaces to make sure these standards are being met;
- fines employers with violations;
- gives workers the right to request inspections, new standards, and health and safety training;
- does not cover public sector workers (see Cal-OSHA below); and
- monitors states that choose to have their own OSHA program.

Cal/OSHA

Cal/OSHA carries out the duties of federal OSHA in California. It also covers all state and local government workers. Its main office is in San Francisco, and it has about 20 district offices throughout the state.

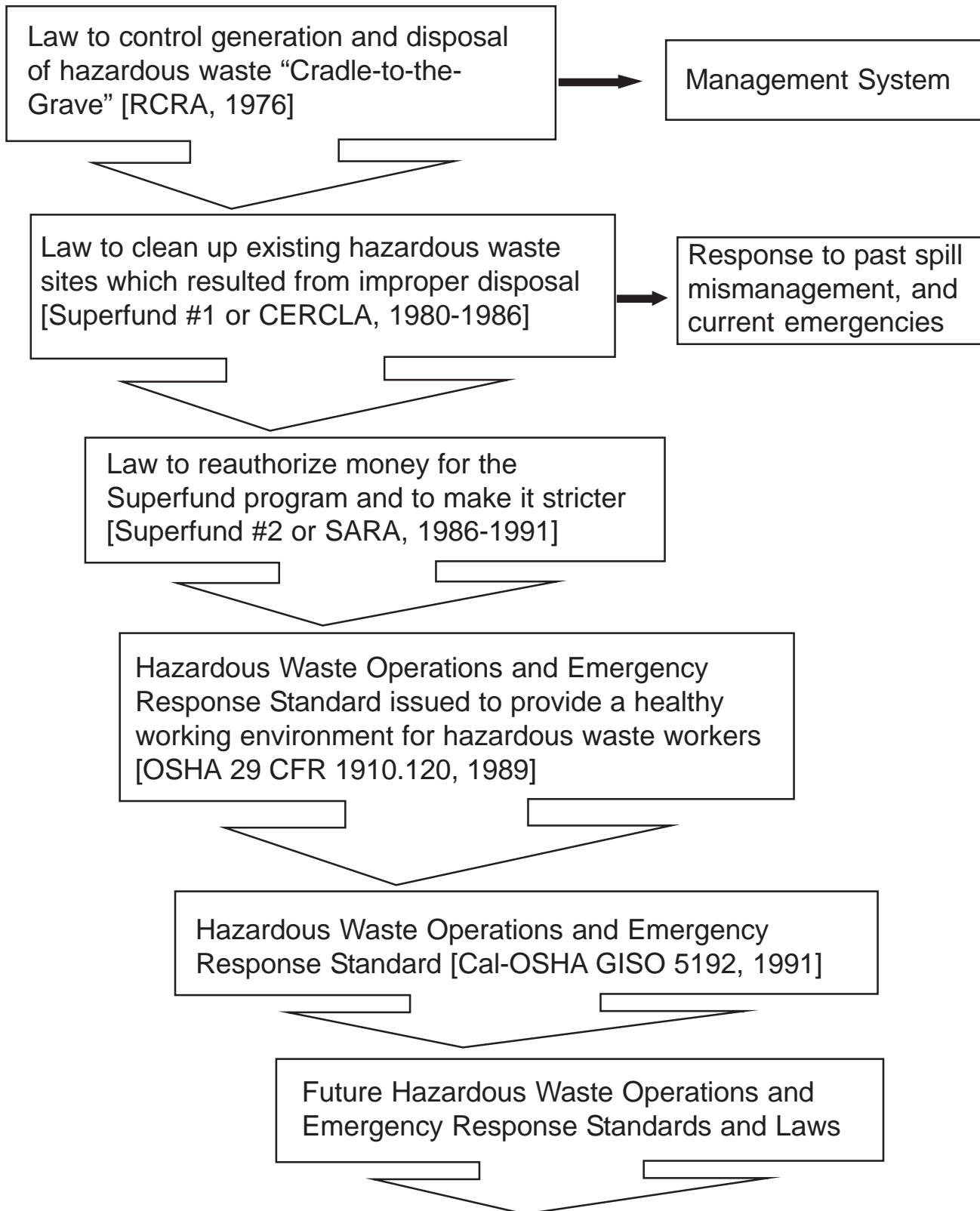


U.S. Department of Transportation (DOT)

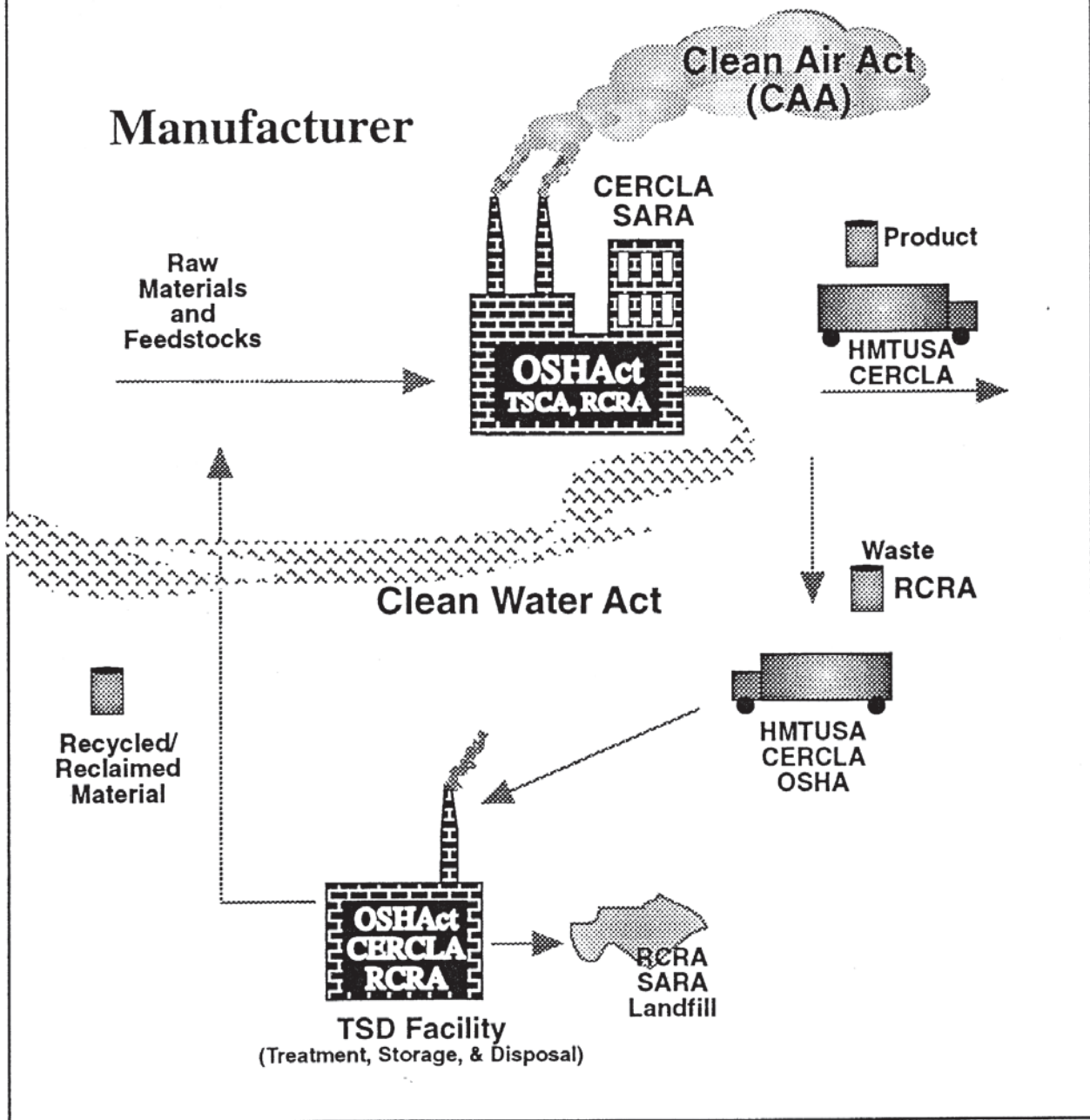
The DOT is a federal agency that:

- regulates the movement of hazardous materials by air, highway, rail or water. Specific requirements are imposed on large numbers of hazardous materials (see 49 CFR 172);
- is charged with restoration of highways, railroads, etc., after hazardous materials spills or releases; and
- governs hazardous material signs, labeling, placarding, documentation, hauling equipment and licensing of haulers. In California, under AB1549, haulers of hazardous materials are required to receive two days of training. (Haulers must comply with California EPA, DTSC, and DOT regulations – along with the vehicle code – enforced by the California Highway Patrol.)

Laws Preceding OSHA's Hazardous Waste Standard



A Few of the Laws Affecting Toxics



- CAA - Clean Air Act
- CERCLA - Comprehensive Environmental Response, Compensation, and Liability Act (Superfund)
- HMTUSA - Hazardous Materials Transportation Uniform Safety Act
- OSHAct - Occupational Safety & Health Act
- RCRA - Resource Conservation & Recovery Act
- SARA - Superfund Amendments Reauthorization Act
- TSCA - Toxic Substances Control Act

Resource Conservation and Recovery Act (RCRA)

1. Enacted in 1976 by the United States federal government.
2. The Environmental Protection Agency (EPA) is the federal agency that implements and enforces RCRA. States can operate their own hazardous waste management (RCRA) program by agreement with the U.S. EPA.

3. Public Law number: PL 94-580. U.S. Code citation:
42 USC 6901 et seq Regulations in 40 CFR 240-271



4. Related California Law: The Hazardous Waste Control Law California Health and Safety Code, Chapter 6.5-6.98, Regulations in Title 26 CCR Div. 22.

5. Provisions:

- regulates solid waste disposal; encourages recycling and alternative waste management technologies;
- establishes a system to identify and track hazardous waste from generator, to transporter, to treatment, long-term storage and/or ultimate disposal (commonly referred to as “cradle-to-grave”);
- sets technical performance and record-keeping standards for facilities that receive hazardous waste for treatment, storage or disposal (TSDFs) and sets standards for state-run RCRA programs; and
- requires licenses for transporters; registration for generators; and extensive, detailed permits for treatment, storage and disposal facilities.

6. RCRA was amended in 1984 to create the Hazardous and Solid Waste Amendment Act (HSWA), which:

- banned bulk hazardous liquid waste disposal in landfills;
- brought underground storage tanks under regulation, including requirements for proper tank installation, leak monitoring, notification and record-keeping, tank design, tank removal, and cleanup of contaminated sites;

- added new requirements for small-quantity hazardous waste generators (those who generate 100 kg–1,000 kg per month);
- increased EPA enforcement authority; and
- restricted waste oil incineration.

Who Is Covered by RCRA?

1. Generators of hazardous wastes

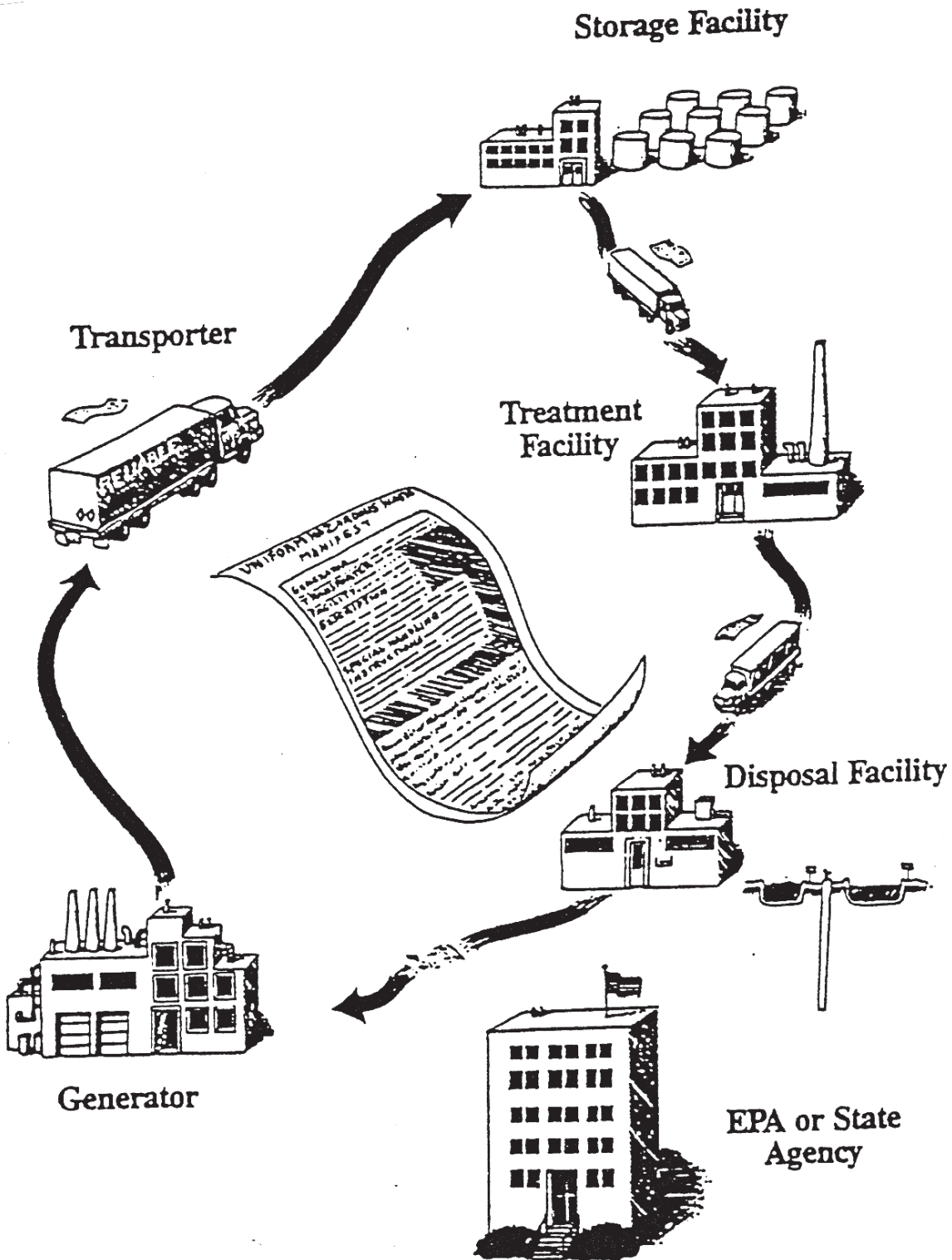
- small-quantity generators: 100kg – 1,000 kg per month
- large-quantity generators: more than 1,000 kg per month

2. **Transporters** must be licensed (by EPA) to haul hazardous waste and must use a Uniform Manifest for every shipment of hazardous waste from the point of generation through treatment, recycling, or ultimate disposal (see next page).

3. **Treatment, Storage, and Disposal Facilities** for hazardous wastes can be operated only under federal or state permit. Facilities subject to permit requirements include those that:

- accept hazardous waste for treatment (including recycling, resource recovery, stabilization, neutralization, solidification, incineration, or **another process**; see Calif. Health and Safety Code, Ch 6.5, or Calif. Code of Reg. (CCR), Title 26, Div. 22, Sec. 66216)
- store a minimum quantity (100 kg) of hazardous wastes **for > 180 days or 1,000 kg for > 90 days** (with certain restrictions); or
- accept hazardous waste for ultimate disposal on-site.

RCRA Uniform Manifest Destiny



A one-page manifest must accompany every waste shipment. The resulting paper trail documents the waste's progress through treatment, storage, and disposal. A missing form alerts the generator to investigate, which may mean calling in the state agency or EPA.

Superfund #1 (1980-1985)

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)

Authority

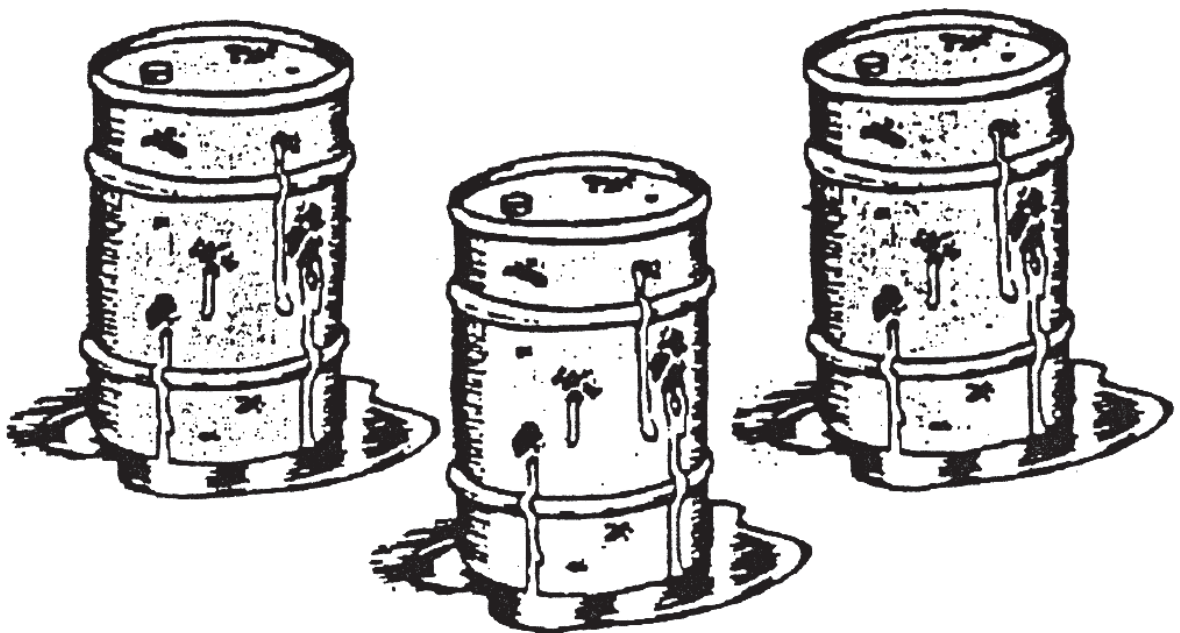
Gives EPA authority to respond to releases of hazardous substances into the environment and to direct and oversee cleanup of old and abandoned waste sites that pose a threat to the public or environment.

Money

Established a fund or “super fund” to pay for clean up of dangerous hazardous waste sites when the responsible party either cannot be located or refuses to pay the costs. This fund is financed primarily by a tax on certain industries.

Priority List

Creates a ranking system, call the National Priorities List, for the hazardous waste sites that are deemed most hazardous to public health and the environment. The sites highest on the list are given priority for clean up.



SARA or Superfund #2 (1986-1991)

Superfund Amendments and Reauthorization Act

Training

- OSHA must create health and safety training requirements for hazardous waste workers and emergency response personnel (result in OSHA 1910.120).
- Funds set aside for training workers, to be given to nonprofit organizations nationwide.

Emergency Planning (SARA Title III)

- State and Local Emergency Planning Committees must be established.
- Plans for emergency response, emergency notification and evacuation procedures must be drawn up.
- Facilities and transportation routes for extremely hazardous substances must be identified.

Community Right To Know (SARA Title III)

- Companies that produce, store or use extremely hazardous substances must notify state and local Emergency Planning Committees of the chemicals they use.
- Large companies (> 10 employees) must submit a list to the EPA and state officials of the hazardous substances that they routinely release into the air, water and soil.

EPA and local officials must be immediately notified of any accidental release of a hazardous substance by a company. Emergency notification by a facility with an accidental release of a hazardous substance must include the following information:

- The name of the chemical
- Whether it is known to be acutely harmful
- An estimate of the quantity released
- The time and duration of the release

- Where the chemical was released (air, water, land)
- Known health risks and necessary medical attention
- Proper precautions, such as evacuation
- The name and telephone number of a contact person at the facility where the release occurred
- A follow-up notice is required after the emergency which updates the initial information and describes the actions taken.

Standard for Hazardous Waste Operations and Emergency Response (HAZWOPER)

- OSHA: 29 CFR 1910.120
- CAL/OSHA: 8 CCR 5192

Purpose:

The purpose of the “HAZWOPER” standard is to protect the health and safety of people 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, it also has special provisions for **on-site treatment, storage and disposal** of hazardous waste at facilities with RCRA licenses from the EPA.



Who Is Covered Under the Standard

1. Hazardous Waste Site Workers:

- a. at federal or state Superfund sites;
- b. at hazardous waste sites designated for cleanup by other government agencies, including during the initial site investigation stage;
- c. 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;
- d. at RCRA-permitted sites with waste areas in need of “corrective action.”



2. TSD Facility Workers:

Workers at federally permitted treatment, storage and disposal (TSD) facilities (under RCRA).

3. Emergency Response Workers:

Anyone involved in on-site or off-site emergency response activities. How the standard applies to your facility varies, depending on whether or not you are an emergency responder, and if so, at what level of response you are involved.



HAZWOPER Training Requirements

Cal/OSHA GISO 5192

1. TSD Workers:

24 hours of general and site-specific training; 8 hours of refresher training annually

2. Hazardous Waste Clean-up Workers:

40 hours of general training : 24 hours for on-site supervised training; 8 hours of refresher training annually; 8 hours of special training for supervisor.

3. Emergency Response Workers:

People who respond to emergencies at TSDD and fixed facilities must be trained. The amount of training depends on their duties. The five levels of training are

:

- (1) first responders “awareness level” for individuals likely to witness a hazardous substance release;
- (2) first responder “awareness level” for individuals who respond from a safe distance;
- (3) Hazardous Materials technician;
- (4) Hazardous materials specialists; and
- (5) on-scene Incident Commanders.

See Cal/OSHA GISO 51929(p)(8) in the Resource Section for more information.

TSD Facility Requirements Under HAZWOPER

Facilities which are permitted under RCRA to treat, store or dispose of hazardous waste, must develop and implement the following components as part of Cal-OSHA 5192:

- 1) A **Hazard Communication Program** Cal-OSHA 5194.
- 2) A **Medical Surveillance Program** (text of standard follows in Appendix A).
- 3) A **Safety and Health Program**: Must be written and designed to identify, evaluate and control safety and health hazards in the facility.
- 4) **Decontamination Procedures** (text in Appendix A).
- 5) A **Training Program**: to enable employees to perform duties in a safe and healthful manner so as not to endanger themselves or other employees.
- 6) An **Emergency Response Plan**: must be rehearsed, reviewed and updated and all emergency personnel trained; an employee alarm system is also mandatory (text in Appendix A).
- 7) A **Material Handling Program** covering handling of drums and containers.

How To Read a Standard Using HAZWOPER

Before we look at the Cal/OSHA standard for hazardous waste work, let's review how to read a regulation.

Cal/OSHA standards are indeed difficult to read. A typical Cal/OSHA standard is subdivided into various section as follows:

- Lower case letters (a, b, c,...) refer to major sections;
- Then a number (1, 2, 3,...) for subsections of major sections;
- Subsections of that subsection use lower case Roman numerals (i, ii, iii,...);
- Then a capital letter (A, B, C,...) for the last subdivision of the subsections.

The HAZWOPER section that requires employers at TSD facilities to provide training, is listed at 8CCR 5192 (p) (7) (A):

8	CCR	5192	(p)	(7)	(A)
Title 8: Industrial Relations	California Code of Regulations	Hazardous Waste Operations & Emergency Response	Operations Covered by RCCA:TSD Facilities	Training Program	New Employees: “...initial training shall be for 24 hours & refresher training shall be 8 hours annually...”



HAZWOPER Table of Contents:

GISO 5192 Hazardous Waste Operations and Emergency Response

	Page
(a) Scope, application, and definitions	1
(b) Safety and health program	4
(c) Site characterization and analysis	6
(d) Site control	8
(e) Training	8
(f) Medical surveillance	10
(g) Engineering controls, work practices, and personal protective equipment for employee protection	11
(h) Monitoring	13
(i) Informational programs	14
(j) Handling drums and containers	14
(k) Decontamination	16
(l) Emergency response at uncontrolled hazardous waste sites	16
(m) Illumination	17
(n) Sanitation at temporary workplaces	19
(o) New technology programs	20

(p) Certain Operations Under the Resource Conservation and Recovery Act of 1976 (RCRA) 20

- (1) Safety and health program
- (2) Hazard Communication program
- (3) Medical surveillance program
- (4) Decontamination program
- (5) New technology program
- (6) Material handling program
- (7) Training program
- (8) Emergency response program

(q) Emergency response to hazardous substance releases by employees not previously covered 22

Appendix A - Personnel 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



How Chemicals Can Harm You



Outline

1. Routes of Entry
 - Nose
 - Skin
 - Mouth
2. Forms of Hazardous Substances
 - Solids (e.g., Fumes/Fibers, Particulates)
 - Liquids
 - Vapors and Gases
3. Types of Toxic Substances and Their Health Effects
 - Acute and Chronic Effects
 - Asphyxiants
 - Irritants
 - Allergic Sensitizers
 - Systemic Poisons
 - Carcinogens, Teratogens, and Mutagens
4. Toxicology Definitions
 - Dose
 - Dose/Response
 - Toxicity vs. Hazard

Objectives

Participants will be able to:

1. Identify the three “routes of entry” through which chemicals enter the body.
2. Discuss how chemicals can move throughout the body.
3. Describe the difference between acute and chronic health effects.
4. Give examples of different types of health effects that can commonly be caused by chemicals on the job.

Routes of Entry

Various forms of chemicals and hazardous substances may enter your body through:

1. Your nose: by inhalation (breathing in);
2. Your skin: by direct contact or absorption through the skin into the body;
3. Your mouth: by ingesting (swallowing) substances into the body;
4. Injection



Inhalation (Nose)

Inhalation, or breathing through the respiratory system, is **the most common route of entry** in the workplace. The respiratory system includes the nose and mouth, airways to the lungs. When the toxic material is inhaled, the respiratory system tries to clear it out.

Absorption (Skin and Eyes)

Contact with a chemical by the skin may cause the following effects:

1. **Local effects on the skin.** Three types of local effects on the skin are:
 - a. **Irritation:** Many chemicals cause an immediate reddening, rash, or other irritation to the skin upon contact. Cresols, mercury and formaldehyde can cause irritation.
 - b. **Tissue damage:** Chemicals such as acids, caustics or corrosives break down the skin or eyes and cause damage to the tissue layers. These effects can be seen as scars, burns or ulcers. Solvents can cause dryness and cracks.
 - c. **Allergic effects:** Some chemicals, such as nickel, chromic acid, beryllium, and isocyanate, cause the skin to become hypersensitive after repeated exposures. This is called **sensitization dermatitis**. The effects can be seen as rash, redness, blisters or swelling.

2. **Systemic (internal) effects from absorption through the skin.** Many solvents are absorbed through the skin, circulated through the bloodstream, and then cause damage within the body. Chemicals that are noted for their systemic (internal) effect upon absorption by the skin are marked with an “S” in the TLV Booklet.

Ingestion (Mouth)

In the workplace, many people may eat or drink harmful chemicals without knowing it. Toxic (poisonous) materials are then absorbed from the digestive tract into the blood. Consequently, **personal hygiene** is essential in the workplace. This requires:

- a. **Washing Facilities**

Your employer is required to provide clean washing facilities (see OSHA Standard 29 CFR 1910.141 and California GISO 3366). Always wash up before eating or smoking.

- b. **Clean Eating and Drinking Areas**

Your employer is required to provide a clean area (with no toxic materials) for eating and drinking (see 29 CFR 1910.14 and GISO 3368). Always eat and drink in clean areas only.

- c. **Smoking**

Smoking is not advised. For those who work with chemicals, smoking has compounded side effects.

The cells that line your upper respiratory tract (bronchia, throat) have small hairs called cilia. These cilia beat back and forth to carry mucus from the lungs **up** into the throat, where it may be swallowed or spit out. Dusts that you breathe can be trapped in the mucus and moved by the cilia to your mouth, where you can swallow them. This is a problem, for example when inhaling, lead fumes in radiator shops, coughing them up and swallowing.

Generally, **ingestion is the least common route** – as long as personal hygiene is maintained and facilities are provided by the employer to help maintain personal hygiene.

Physical Forms of Hazardous Substances

As with any substance on Earth, a chemical hazard may take the form of a **solid**, a **liquid**, or a **gas**. As a substance is cooled or heated it may change from one form to another. The hotter the workplace (or the more heat used in the process), the more a liquid solvent will evaporate and give off harmful vapors. Metal particulates can also be emitted as fumes from extremely hot processes such as welding.

Solids

Solids most dangerous to your health are dusts, fibers, and fumes. These types of solids are so small that they can be inhaled directly into the lungs, where they may damage the lungs or pass into the bloodstream to harm other parts of the body.

Dusts are solid particles made by handling, blasting, crushing, or grinding materials such as rock, metal, coal, wood, or grain. Any process that creates dusts should be considered hazardous until industrial hygiene monitoring proves it safe.

Fibers are particles whose shape is long and narrow rather than rounded. If the length is three or more times the width of a particle, it is called fiber. The most well-known fiber in industry is the asbestos fiber.



Fumes are tiny solid particles produced by heating metals. Fumes are produced mainly in industrial high-heat operations, such as welding, melting, and furnace work. Fumes are often mixed with hazardous gases, such as ozone and nitrogen oxides, which are inhaled by the lungs at the same time.

Aerosol is the general term for any airborne particle, whether solid or liquid.

Particle size is important in determining how harmful a particle is to your health. Particles range in size from 0.1 to 25 micrometers. Only particles of less than five micrometers stay suspended in the air long enough to be inhaled. **These fine particles cannot be seen without a microscope, but they are the most dangerous to your health because they penetrate into your lungs.**

Liquids

Liquid aerosols, mists or sprays are fine liquid droplets suspended in air.

Examples are:

- oil mist produced during cutting and grinding operations
- acid mist from electroplating
- acid or alkali mists from plating operations
- paint spray mist

Mists are aerosols. The finer the aerosol spray, the easier it is to inhale and the more damage it does. Most mists, such as paint spray, are mixtures of several ingredients solvent, pigment, stabilizing agents, and propellants.

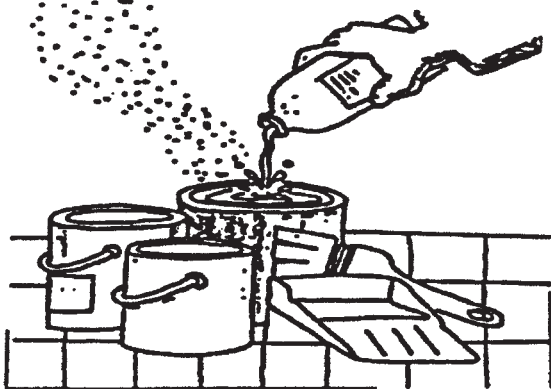
IMPORTANT Any liquid splash or spill can also enter the body through the skin, and then enter the bloodstream to do damage.

Vapors and Gases



A **gas** is a fluid that expands quickly to fill the space that contains it. Many gases are highly flammable; many are very reactive, both chemically and within the body.

A **vapor** is the technical name for the **gaseous form of a liquid that always exists above that liquid** – just as water vapor always exists over water.

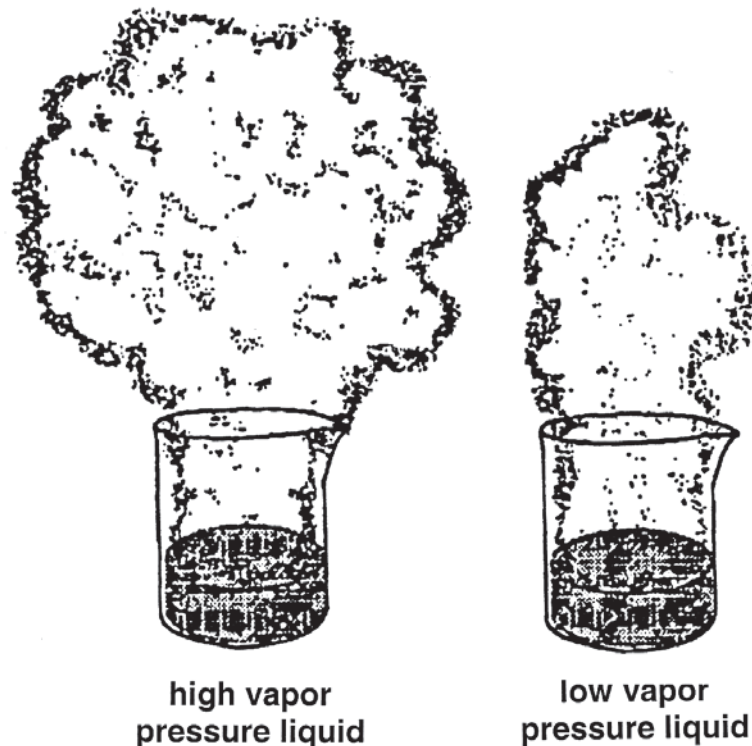


The closer a liquid is to its boiling point, the more it vaporizes. Liquids with boiling points just above room temperature vaporize readily, and are called volatile.

Vapor Pressure:

Vapor pressure (VP) is a measure of how easily a vapor is released from a liquid at a given temperature. It also indicates how quickly we inhale the vapor. It is measured in millimeters of mercury (mm Hg).

A chemical with a high vapor pressure releases a lot of vapor at a given temperature. The vapor pressure of a substance provides a warning of the possibility of an explosion. High vapor pressure chemicals that are kept in closed containers may explode if there is a fire or if the environmental temperature becomes high enough.



The higher the vapor pressure of a given chemical, the greater the chemical's potential as a fire and/or health hazard.

Following are examples of chemicals that have high vapor pressure (more than 10 mm Hg), medium vapor pressure (between 1 and 10 mm Hg), and low vapor pressure (less than 1 mm Hg):

(Measured at 68° F)

Chemical Name	VP	
Sulfuric Acid	.001 mm Hg	<i>Low Vapor Pressure</i>
Ethylene Glycol Diethyl Ether	9.4 mm Hg	<i>Medium Vapor Pressure</i>
Acetone	180 mm Hg	<i>High Vapor Pressure</i>

Vapor Density (VD):

The density of a vapor is similar to the “heaviness” of that vapor in comparison to air. The vapor density of air is 1. If the VD is greater than 1, the vapor or gas is heavier than air and will concentrate in low places.

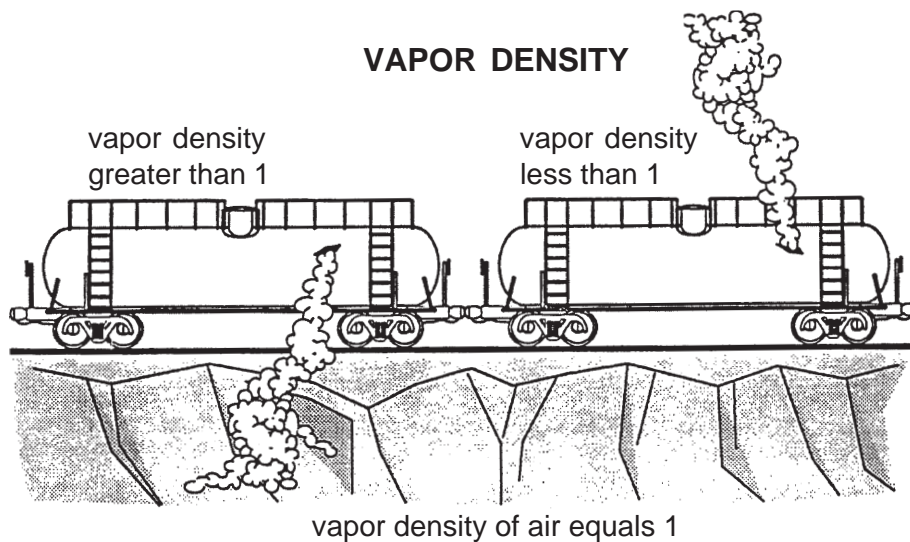
Vapor density is important in determining whether a vapor will tend to rise to the ceiling (density less than 1, “light”) or sink to the floor or bottom of a tank (density greater than 1, “heavy”).

VD greater than 1	VD less than 1
Trichloroethylene: 4.50	Ammonia: .59
Methylene Chloride: 2.9	Ethylene: .97
Gasoline: 4.4	

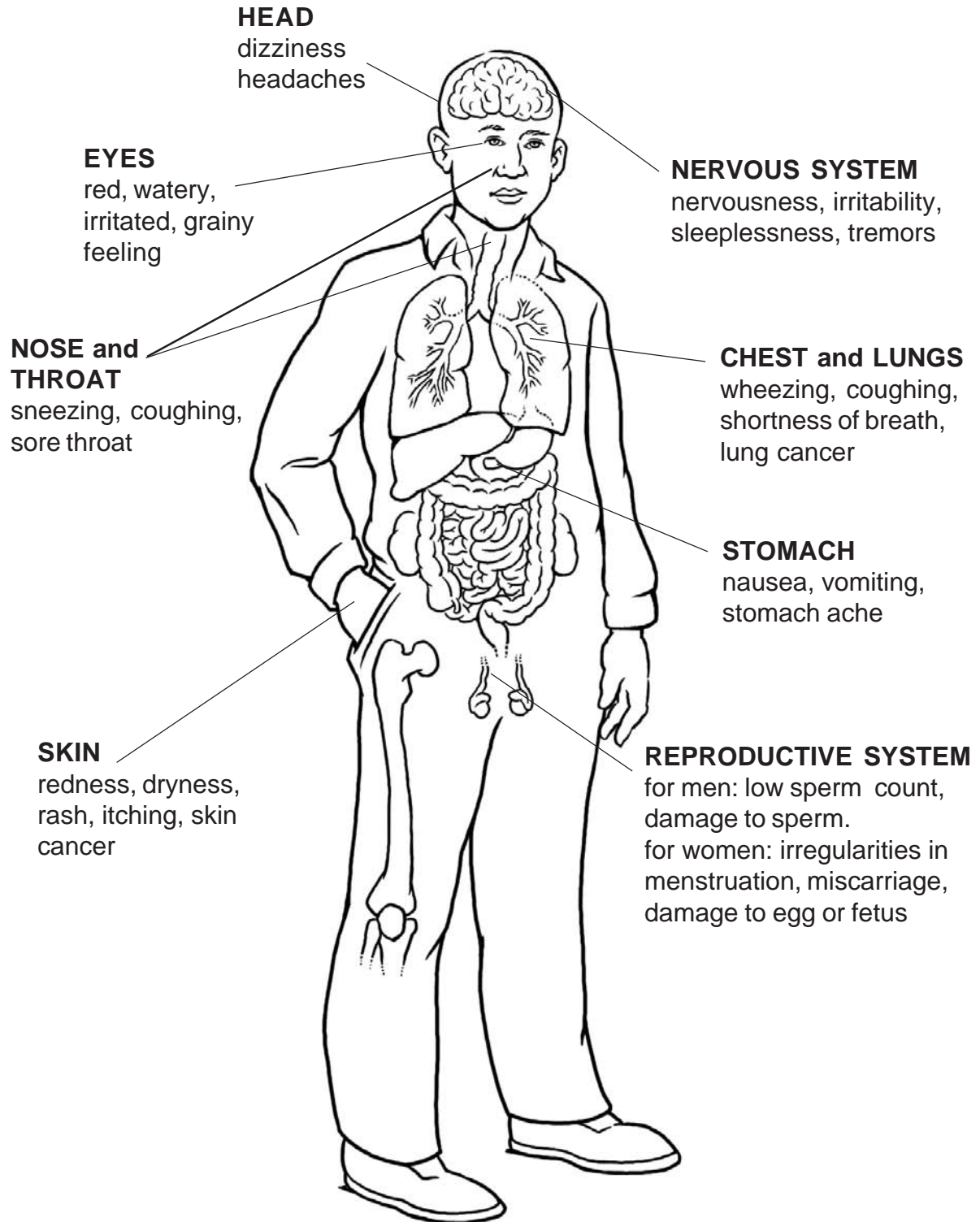
* If you don't know the vapor density of a chemical you can look up (in the NIOSH Pocket Guide) its molecular weight (MW). If the MW is more than 29, its vapor is heavier than air.

You should be cautious when working with **vapors with high vapor density (“heavy” vapors)** for the following reasons:

- They remain close to the floor and they settle in small spaces. They can **take the place of oxygen in the environment**, leading to asphyxiation (or suffocation).
- They can be **flammable**. They can travel far from the liquid source and ignite very easily. Gasoline is a vapor that moves quickly along the ground and ignites easily, far from the liquid source.



How Chemicals Can Affect the Body



How Chemicals Can Affect Your Health

These symptoms may be caused by chemicals or other conditions at work:

Symptom	Common Causes
HEAD Dizziness, headaches	Solvents, paint, ozone, smoke (including tobacco)
EYES Red, watery, irritated, grainy feeling	Smoke, gases and vapors, fumes, dusts, ultraviolet (UV) radiation, paint, cleaners
NOSE and THROAT Sneezing, coughing, sore throat	Smoke, ozone, solvents, dust, paint, cleaners
CHEST and LUNGS Wheezing, coughing, shortness of breath, lung cancer	Metal fumes, dust, smoke, solvents, paint, cleaners
STOMACH Nausea, vomiting, stomach ache	Some metal fumes, solvents, paint, long-term lead exposure
SKIN Redness, dryness, rash, itching, skin cancer	Solvents, radiation, chromium, nickel, detergents and cleaners, paints
NERVOUS SYSTEM Nervousness, irritability, sleeplessness, tremors	Long-term solvent exposure, long-term lead exposure
REPRODUCTIVE SYSTEM For men: low sperm count, damage to sperm. For women: irregularities in menstruation, miscarriage, damage to egg or fetus	Lead, toluene and some other solvents, radiation, ethylene oxide

Types of Toxic Substances and Their Health Effects

Toxic substances can have two general types of effects: acute and chronic:

An **acute effect** occurs when one feels symptoms within a short time, such as within minutes or hours. Examples of acute effects include:



In contrast, a **chronic effect** or illness develops slowly and may last for a long time. Chronic poisoning is usually due to continued exposure to a harmful chemical for months or years. Examples of chronic effects include **cancer, sterility, kidney and liver damage**.

In short: Be aware of both the **acute** and **chronic** effects of a hazardous substance.

There are five types of toxic effects that hazardous substances may have on the body. A single hazardous substance can, of course, have more than one type of effect at the same time.

Asphyxiants

A **simple asphyxiant** displaces the oxygen in the environment necessary to maintain life. Examples are: carbon dioxide, ethane, helium, hydrogen, methane, and nitrogen.

A **chemical asphyxiant** prevents the uptake of oxygen by the cells of the body. Examples are: carbon monoxide, hydrogen cyanide, and hydrogen sulfide.

At high levels, all asphyxiants can cause collapse, unconsciousness or death.

Irritants

An irritant is a material that causes inflammation to a part of the body by direct contact. The two types are **respiratory irritants** and **irritants to the skin**.

Respiratory irritants cause injury to the nose, mouth, throat and lungs. Materials that are very water soluble affect mainly the nose and throat (e.g., ammonia, formaldehyde). Less water-soluble materials act deeper in the lungs (e.g., nitrogen dioxide, phosgene). Examples of chemicals that affect both the upper and lower lung are chlorine and ozone.

Respiratory tract irritation can be minor, such as a tightening of the chest or bronchitis. But it may also be very serious, as in the case of pulmonary edema and death.

Skin irritants may cause contact dermatitis, a redness, itching and drying of the skin. Examples are organic solvents and detergents. Very corrosive agents, such as chromium and nickel, can cause ulcers and destroy tissue.

Allergic Sensitizers

After repeated exposures to certain chemicals, some individuals experience an allergic (or immune) reaction. Allergic sensitizers generally affect the skin and respiratory tract. The symptoms are often the same as those caused by irritations. Examples of such symptoms include dermatitis or bronchitis. As with irritations, the response may be very serious, and may even cause death. Examples include: isocyanates, formaldehydes, phenol resins, and epoxy resins.

Systemic Toxicant Materials (Internal Poisons)

Blood System (Hemolytic) Toxicants

These damage blood cells or interfere with blood cell formation.

Examples include benzene, methylene chloride, arsine, phosphorus, and naphthalene.

Nervous System (Neuro) Toxicants

These damage the nervous system. Typical symptoms include dullness, muscle tremor, restlessness, convulsions, loss of memory, epilepsy, and loss of muscle coordination.

Examples include mercury, insecticides, hexachlorophene, and lead.

Liver (Hepato) Toxicants

These cause liver damage, including jaundice and liver enlargement.

Examples include alcohol, carbon tetrachloride, and nitrosamines.

Kidney (Nephro) Toxicants

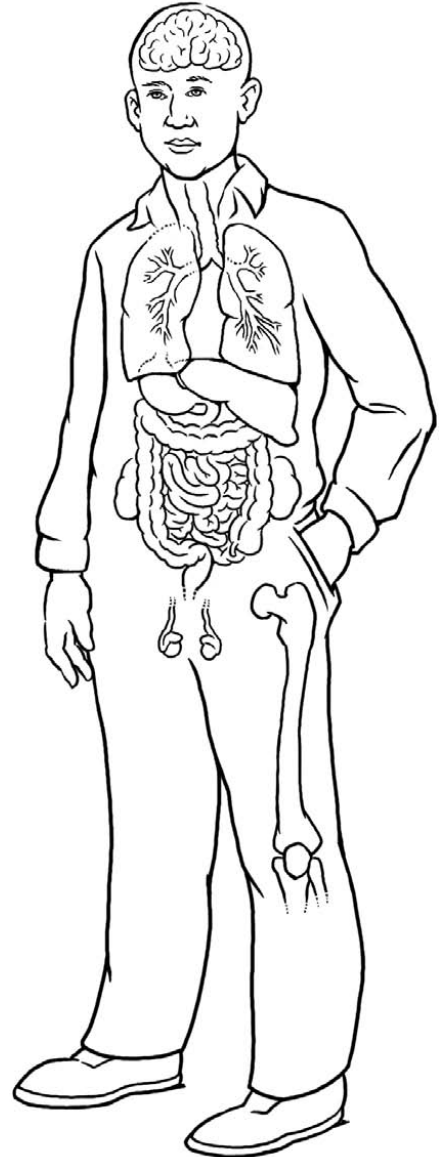
These damage the kidney, causing swelling and increased serum proteins in the urine.

Examples include halogenated hydrocarbons and heavy metals.

Reproductive Cell (Gameto) Toxicants

These damage reproductive cells (egg and sperm) or interfere with their formation.

Examples include DBCP, lead, cadmium, cellosolves, and vinyl chloride.



Carcinogens, Teratogens, and Mutagens

Carcinogens

Carcinogens cause cancer. Cancer is the uncontrolled growth of malignant (harmful) cells at any site in the body. The development of cancer may be delayed for 20 to 30 years.

Examples include: vinyl chloride, asbestos, ethylene dibromide, and acrylonitrile.

Teratogens

Teratogens cause physical defects in a developing embryo or fetus. In the 1960s, methyl mercury was the first industrial chemical shown to be a teratogen.

Other examples include thalidomide, anesthetic gases, and ionizing radiation.

Mutagens

Mutagens cause a change (mutation) in your genetic material. Mutation of the reproductive cells may cause birth defects in future children. Mutation of other cells in the body may cause cancer or defects in developing embryos or fetuses.

Examples include ethylene oxide (a sterilizing chemical used in hospitals), benzene, hydrazine, and ionizing radiation.



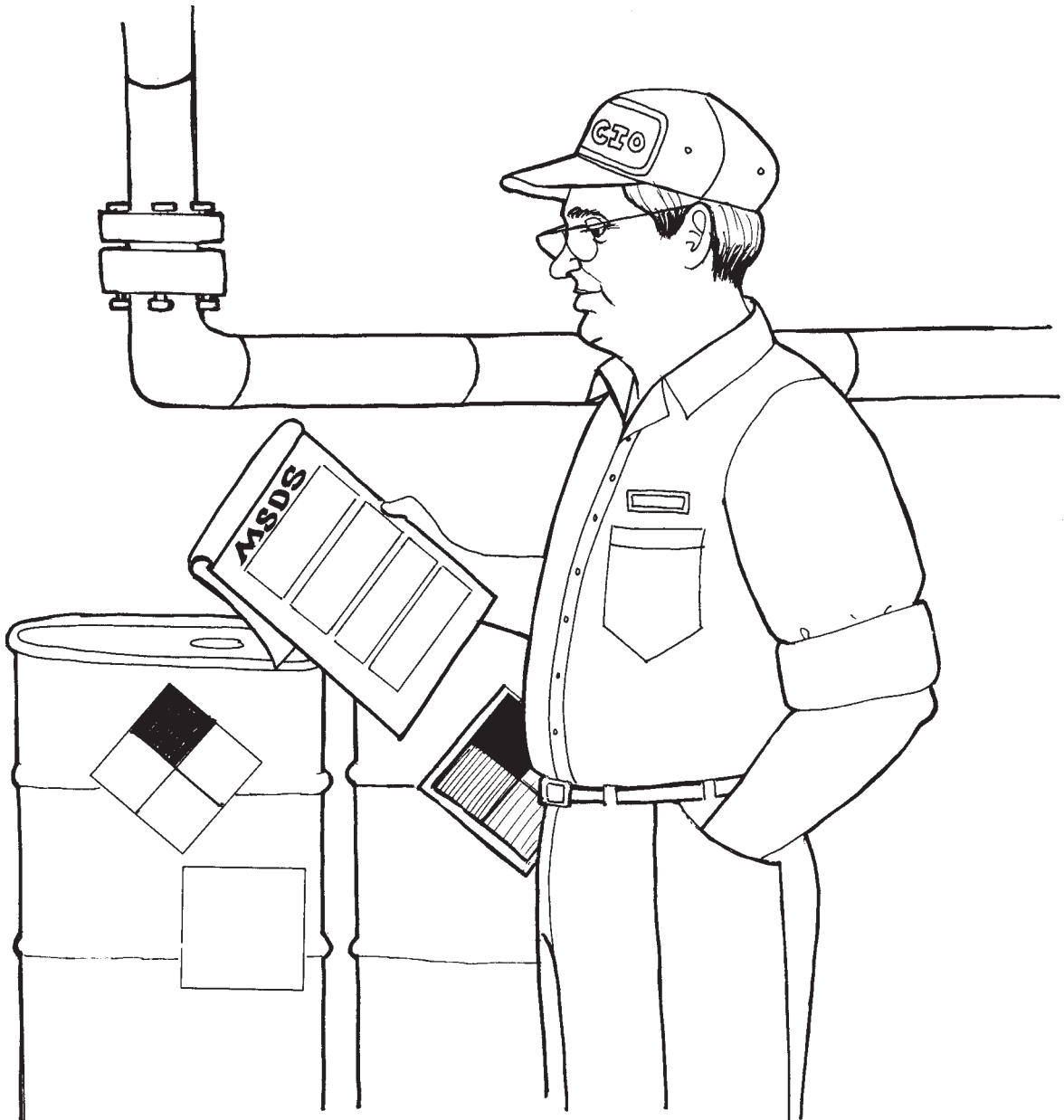
Dose Response: The More Poison, The Greater the Harm

An exposure is the amount of chemical that is in the air you breathe, or is on your skin or on the food you eat. The dose is the amount of the substance you actually absorb into your system. With most chemicals it is easier to measure the exposure than the dose. In general, as the exposure increases, dose also increases. So the higher the exposure, the greater the number of people who experience symptoms. This is called a dose/response relationship. Small doses may cause milder symptoms such as headaches or respiratory irritation, while higher doses may cause life-threatening damage to vital organs.

Will a Worker Get Sick? It Depends on . . .	Examples
How toxic the chemical is	The more toxic, the more likely it will cause health problems, even in small amounts. Methyl alcohol, which can cause blindness, is more toxic than ethyl alcohol, which is used in alcoholic beverages. Methylene chloride and acetone are both solvents, but methylene chloride is much more toxic.
The amount of chemical that a worker is exposed to (that is in the air he or she breathes, or that comes in contact with the skin or mouth)	Acetone is an industrial solvent that is also found in nail polish remover. It is more dangerous to the worker who uses larger amounts of it than the person who uses a small amount of nail polish remover.
How long the worker is exposed to the chemical	Someone may work with a chemical for half an hour per day, while another person is exposed 8 hours a day. Also, someone may be exposed for one month, while another person may have 20 years of exposure.
How the chemical get into the person's body (route of entry)	Some chemicals, like the pesticide parathion, are very toxic whether they get into the through the skin, by breathing or ingestion. On the other hand, asbestos is most harmful when inhaled. For example, a house may have asbestos insulation, but unless the asbestos is disturbed and becomes a dust in the air, it can't breathe in, so it won't cause harm.
Individual factors (e.g. heredity, body size, age, whether he or she smokes or drinks, allergies, sensitivities, exposures to other toxic chemicals)	Lead is much more harmful to small children than adults because it affects their developing brain and central nervous system. If two people work with asbestos and one of them smokes, the one who smokes is more likely to develop asbestos-related lung cancer than the nonsmoker.



Sources of Information: MSDSs and More...



Outline

1. Your Right To Know: OSHA Hazard Communication Standard
2. Labels
3. Material Safety Data Sheets (MSDSs)
 - Review of topics covered
 - Limitations of MSDSs
4. Other Sources: A Brief Overview
 - HMIS (Hazardous Materials Identification System)
 - DOT Emergency Response Guide
 - NFPA Diamonds (National Fire Protection Association)
 - Other
5. Evaluating a Hazard Communication Program
6. Training

Objectives

Participants will be able to:

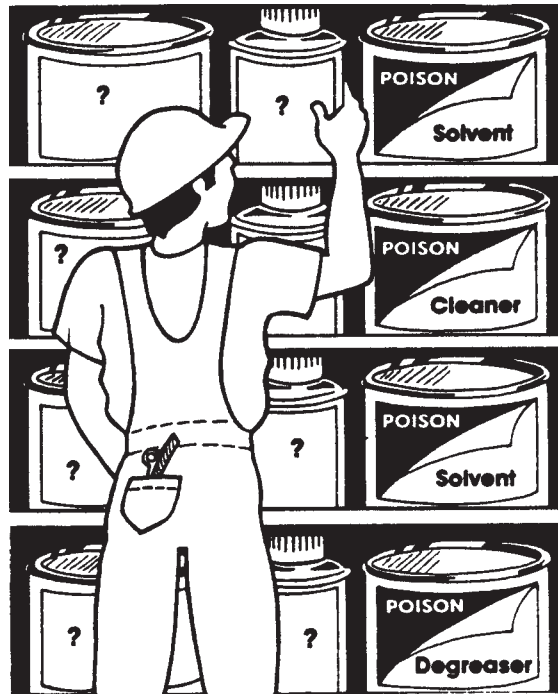
1. Name at least two sources of information that can help workers learn about the hazards of chemicals they work with.
2. Recognize each resource and explain the type of information that can be found in:
 - Material Safety Data Sheets (MSDSs)
 - Labels
3. Use the different resources to find answers to their questions about health and safety on the job.

“Right To Know”

Hazard Communication Standard

The Hazard Communication Standard (GISO 5194) gives you the right to information that can answer the following questions:

1. What is hazardous in this material?
2. How can this affect my health?
3. What other hazardous materials are used at my workplace?



Federal and state OSHA programs give workers the right to know what hazardous materials they could be exposed to by requiring employers to set up a “Hazard Communication Program,” including:

- **LABELS** on all hazardous materials
- **MSDSs (Material Safety Data Sheets)** for all hazardous materials
- **TRAINING** for all employees

Labels must include:

- the name of the hazardous substance (the same name as is on the MSDS).
- specific warnings about potential hazards and short- and long-term health effects.
- the name and address of the chemical manufacturer, importer, or other responsible party.

MSDSs must include:

- the product name and ingredients.
- physical and chemical characteristics.
- fire, explosion, and reactivity hazards.
- health hazards: symptoms, routes of exposure, potential to cause cancer.
- legal exposure limits.
- precautions for safe handling and use.
- protective control measures.
- personal protective equipment.
- emergency and first aid measures.
- spill and leak procedures.



Training must include:

- physical and health effects of the hazardous substances.
- methods used to detect the presence or release of hazardous chemicals.
- measures employees can take to protect themselves from hazards (including how to read and use labels and MSDSs to protect themselves).

Chemical Labels

What Can I Find Out from a Chemical Label?

Under the Right to Know laws, labels from suppliers **only** need to contain the following information:

1. Product Identity, such as chemical or trade name.
2. Hazard Warning, including what type of hazard (for example, lung or kidney damage).
3. Name and Address of the Manufacturer.

Some labels may include additional information and include words like “**caution**” or “**harmful if breathed**”.

SODIUM HYDROXIDE

CAUSTIC SODA: LYE

POISON!

DANGER!

**CAUSES SEVERE BURNS
MAY BE FATAL IF SWALLOWED**

Do not get in eyes, on skin, on clothing. Avoid breathing dust. Keep in tightly closed container. Use adequate ventilation. Wash Thoroughly after handling.

EFFECTS OF OVEREXPOSURE: Ingestion may result in severe intestinal irritation with burns to mouth. Contact with skin or eyes may cause severe irritation or burns.

FIRST AID PROCEDURE: If swallowed, do NOT induce vomiting. If conscious, give large amounts of water. Follow with diluted vinegar, fruit juice, or whites of eggs, beaten with water. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before re-use.

Consult MSDS for further hazardous information and instructions.

CAS No. [1310-73-2]

What Is Often Missing from a Chemical Label?

There is a lot of information that you cannot find out from a chemical label:

1. What to do if the chemical spills.
2. How to store the chemical safely.
3. How to protect yourself from harmful health effects.

Remember: All chemical products in the workplace should have labels. If a chemical is poured into a smaller container and taken to another department in the plant, it needs to have a label.

What Information Does an MSDS Have To Include?

Under the Right-To-Know law, an MSDS must contain certain information. However, there is no requirement that all MSDS's be designed or formatted the same. Some MSDS's may have 8 sections; some may have 16 sections. Some MSDS's are 1 or 2 pages; others are as long as 20 pages!

MSDS's Must Include:

1. Product identity and ingredients.
2. Physical and chemical characteristics.
3. Fire and explosion hazards.
4. Reactivity information.
5. Health hazards: symptoms and routes of exposure and potential to cause cancer.
6. Legal exposure limits.
7. Precautions for safe handling and use.
8. Protective control measures.
9. Personal protective equipment.
10. Emergency and first aid measures.
11. Spill and leak procedures.

Material Safety Data Sheets

Material Safety Data Sheets (MSDS) contain information about the properties of workplace chemicals. They are usually written by the supplier or manufacturer of the chemicals.

What Can I Find Out from a Material Safety Data Sheet?

An MSDS is divided into sections, each with different information about the chemical. The table below tells you some of the information you can find.

Questions	What to look for	Sections of an MSDS
Who makes it?	Manufacturer's name	Section one
What is this stuff?	<ul style="list-style-type: none">• Ingredients• Who makes it	Hazardous ingredients Identity
Can this product hurt my health?	<ul style="list-style-type: none">• Health effects• Symptoms• Cancer hazard• First Aid	Health Hazard Data
Is this product dangerous?	<ul style="list-style-type: none">• Fire and explosion hazard• Materials to avoid• Stable or unstable	Fire and Explosion Hazard Data Reactivity Data Special Precautions
How can I protect myself?	<ul style="list-style-type: none">• Personal protective equipment• Control measures• Work/Hygiene practices	Controls Measures Special Precautions Spill Procedures
How should the product be handled?	<ul style="list-style-type: none">• Safe handling & storage• Fire & spill procedures• Waste disposal	Precautions for Safe Handling & Storage Spill Procedures
Where do I get more information?	<ul style="list-style-type: none">• Name and telephone number	Section one

What Is This Stuff?

When you work with a product and have questions about it, the MSDS must correspond to the container label so you can match the MSDS to that product. Since MSDSs sometimes are not very complete or accurate, you may need the scientific names of the ingredients to get more accurate information from other sources, such as your NIOSH pocket guide. There are two sections on an MSDS that can help you get this information.

Section: Product Identity

This section provides the information you need in order to match the Material Safety Data Sheet with the product label in your workplace.

Section: Hazardous Ingredients

This important section of the MSDS gives you the information you need to get additional information not provided on the MSDS.

No ingredients need to be listed if the product is a pure, single chemical, and if the product name is the same as the chemical name. Frequently, many workplace chemicals are not one single substance but are made up of different ingredients. (Just like a cake is a mixture of items like eggs, butter, flour, etc.) When it is a mixture, you should see a listing of the hazardous ingredients on the MSDS. Some of the ingredients will be more hazardous than others.

For each ingredient, the MSDS must list the chemical name of that ingredient. Since a chemical can have more than one scientific name, there are unique numbers assigned to each chemical called “C.A.S.” numbers (Chemical Abstract Service). It is often easier to write down the C.A.S. number than a long chemical name. The C.A.S. number will be useful in looking up the chemical, by you or someone helping you, in other books.

The Hazard Communication Standard says an MSDS must list the exposure limits (the PEL and the TLV) of each ingredient to which you may be exposed. Exposure limits are explained earlier in this chapter.

Can This Product Hurt My Health?

Section: **Health Hazard Data**

This section will give you information not only on what problems the product can cause, but also how it gets into your body. Some of the words used may be medical or technical terms. Again, with a little patience, you can find the answer to your questions. If the information is not complete, you can get the names of the ingredients listed in the Section on Hazardous Ingredients and do more research.

Routes of Entry – This section should tell you if a chemical can enter your body by inhalation, skin absorption or ingestion.

Health Hazards – This part describes the harmful effects of the substance on your health. These health hazards may be acute hazards (short-term) or chronic health hazards (long-term).

Data sheets must tell you about both kinds of health effects – chronic and acute. But since so little is known about the effects of continual, low-level exposures, most of what you learn from a MSDS will be acute health effects. If the effects listed are in medical terms, you may want to show the MSDS to your doctor.

Carcinogenicity – This section will tell you if any chemicals in the product can cause cancer. The MSDS must indicate who decided the substance could cause cancer. There should be boxes for the three agencies that make this determination. Because OSHA regulates only a few carcinogenic chemicals, other agencies are also used. The MSDS will show the agencies with a box, such as, NTP (National Toxicology Program), OSHA, IARC (International Agency for Research on Cancer). A chemical may not be listed as a carcinogen even though studies have shown it to cause cancer. This is because NTP and IARC are limited in the number of chemicals they can evaluate. Most chemicals have not been thoroughly tested for carcinogenicity.

Signs and Symptoms of Exposure – Symptoms are what you feel from being exposed (such as skin irritation). Signs are what a doctor sees on examining you following exposure (such as blood changes).

Medical Conditions Generally Aggravated by Exposure – People with a pre-existing medical condition may be affected by a chemical exposure more seriously than others.

Emergency and First Aid Procedures – First aid should be described for all routes of entry. If no information is listed here, your employer should call the manufacturer before there is an emergency. If there is an emergency, get medical attention from the nearest health professional. Bring a copy of the MSDS to the emergency room so health care providers have information on the chemical product.

Is the Product Dangerous?

As discussed, a workplace chemical can pose physical hazards. The following sections usually can tell you if a chemical can explode, react and/or cause a fire.

- Fire and Explosion Data
- Flammable or Explosive Limit
- Flash Point
- Reactivity Data

How Should the Product Be Handled?

There are many important practices and procedures that you may want to know and recognize that will reduce the possibility of a spill, fire or explosion. These can be found on the MSDS in the section usually titled “special precautions” and “safe handling and storage.”

Section: **Precautions for Handling**

Steps To Be Taken In Case Material Is Released or Spilled – Many MSDSs deal with this section by saying “avoid breathing gases and vapors,” or “avoid contact with liquids.” This is clearly insufficient. This section should provide detailed information for responding to an emergency and how to handle smaller spills.

Waste Disposal – Any special procedures that should be used for disposing of hazardous workplace materials are noted here. Your employer should not dump hazardous waste in the garbage or down the drain or in an unlicensed landfill. It exposes the city or town disposal workers and your neighbors to unknown hazards. If you have any questions about disposal methods, you can contact the Environmental Protection Agency’s special hotline number: (800) 424-9346.

Precautions To Be Taken In Handling And Sorting – This section may advise, for example, not to store acids and bases together, or organic chemicals around strong oxidizers, or to keep some chemicals in temperature-controlled areas.

Other Precautions – This section is a catch-all for any special precautions that may not have been discussed. Always check this section because sometimes information that should be listed somewhere else is listed here instead.

How Can I Protect Myself?

Section: Control Measures

The best control measures for chemicals are those that **reduce or eliminate the problem at the source** (before anyone can have contact with it). Engineering controls are the next best thing. Engineering controls may mean supplying direct ventilation to a chemical process. **Personal Protective Equipment (PPE)** refers to items like respirators, goggles or gloves. **Work practices** may mean never using a material near or around heat sources.

Personal Protective Equipment (PPE) – respirators, clothing, goggles – should be the last resort. Other control measures should be exhausted before PPE is used. [Unfortunately, on hazardous waste sites it is usually not possible to control hazardous exposures well enough and PPE is use regularly.] The MSDS should list very specifically what kinds of respirators need to be used, the type of glove material that is protective, etc.

Local Ventilation – This type of ventilation uses an exhaust fan at the end of an enclosure that draws the dust, fumes, gas, mist or vapors away from the source. An example of local exhaust is a paint spray booth.

Dilution (General) Ventilation – This type of ventilation dilutes the chemicals in the air with clean air in a general area, room or building. An exhaust fan in the wall or ceiling is not very effective unless fresh air is brought in at the same time.

Work/Hygienic Practices – This section may deal with things like washing hands before eating or leaving the area, restricting food or drink in work areas, keeping areas free from dusts or liquids.

Where Do I Get More Information?

The name, address and phone number of the manufacturer or supplier must be on the MSDS. The firm responsible for the information on the MSDS may well know more about the substance. Do not hesitate to call if you have a question.

An MSDS As a Tool

An MSDS is like any tool, you need to use it to become aware of its strengths and weaknesses. All MSDSs are not created equal: some are incomplete, others are inaccurate. You will find as you get used to reading different MSDSs that you will begin to gain a sense of when you have a poor one. Approach an MSDS with the checklist of questions that is used at the beginning of this section. If you still have questions, there are usually agencies and resources available.

Do Not Rely Only on MSDSs

In 1994, OSHA funded a study which evaluated the accuracy of information on 150 MSDSs. The study found:

- only 37% had accurate information about health problems caused by ingredients;
- only 47% had accurate information about legal limits and protective equipment;
- only 76% had accurate information about first aid;
- only 11% had accurate information in all four areas above.

Most MSDSs did not have **wrong** information, but they did not mention health problems, equipment that workers needed, or legal limits that have been set.

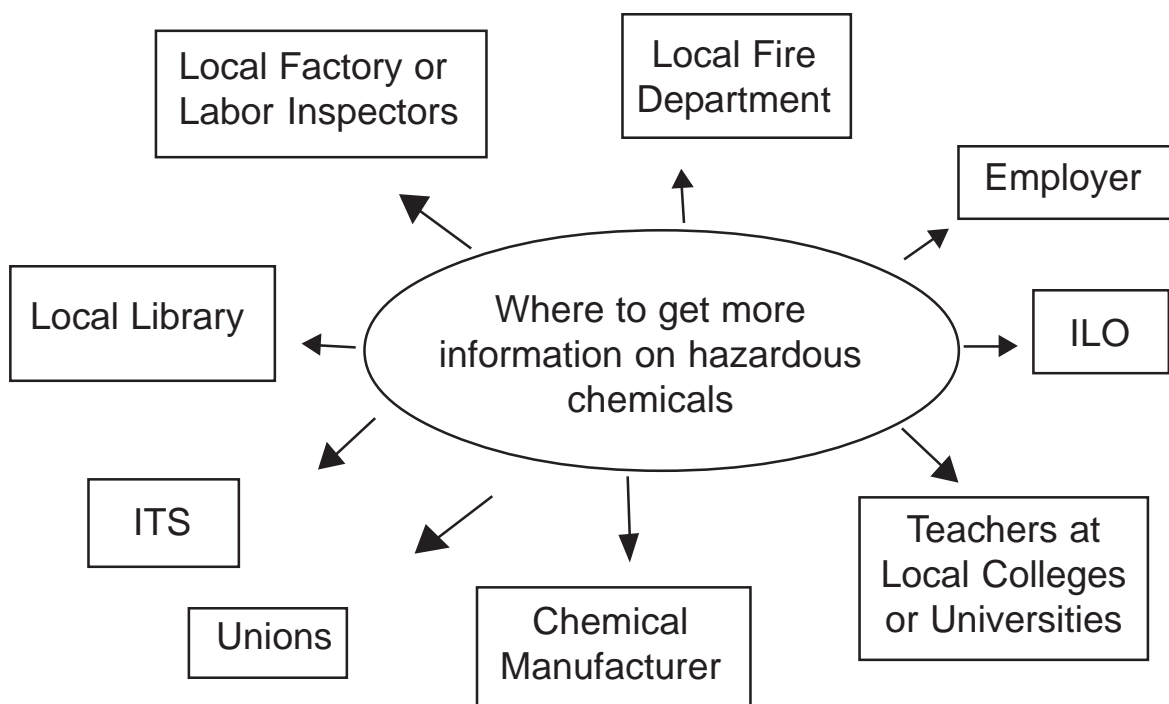
The lesson – look at MSDSs, but check them with other sources such as the *NIOSH Pocket Guide* to make sure information was not left out.

Limitations Of MSDSs

Some MSDSs can tell you a lot about the hazards of a chemical. They may be the only source of information about chemicals at a workplace.

Yet, many MSDSs are missing valuable information. They may use a lot of technical words and can be hard to understand. Others are out of date or contain inaccurate information.

Remember, all MSDS's are not created equal. Do not rely on the MSDS sheets alone. Try using other sources of information as well.



Hazardous Materials Identification System

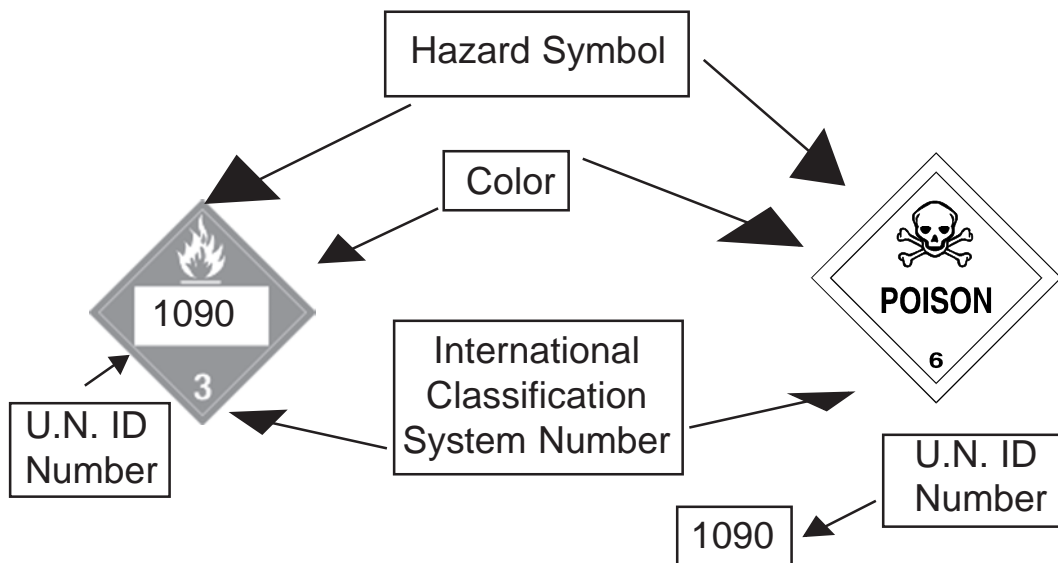
The Hazardous Materials Identification System may be seen in many workplaces. It provides some information about the kinds of protective equipment that may be needed in the work area. It must be supplemented by training and more specific labeling as required by the Hazard Communication Standard.

This system differs in some ways from NFPA and the EPA. Although the colors are the same as the NFPA 704 diamond (Health, Flammability, and Reactivity), the hazard ranking may differ. Also note that the Protective Equipment Index differs from the EPA Levels of Protection.



Overview of DOT Placards

Dot placards and labels on trucks and rail cars can give first responders quick information on potential hazards. If you work in areas where vehicles carrying these placards are used, it is in your interest to know what the symbols, colors and numbers mean.

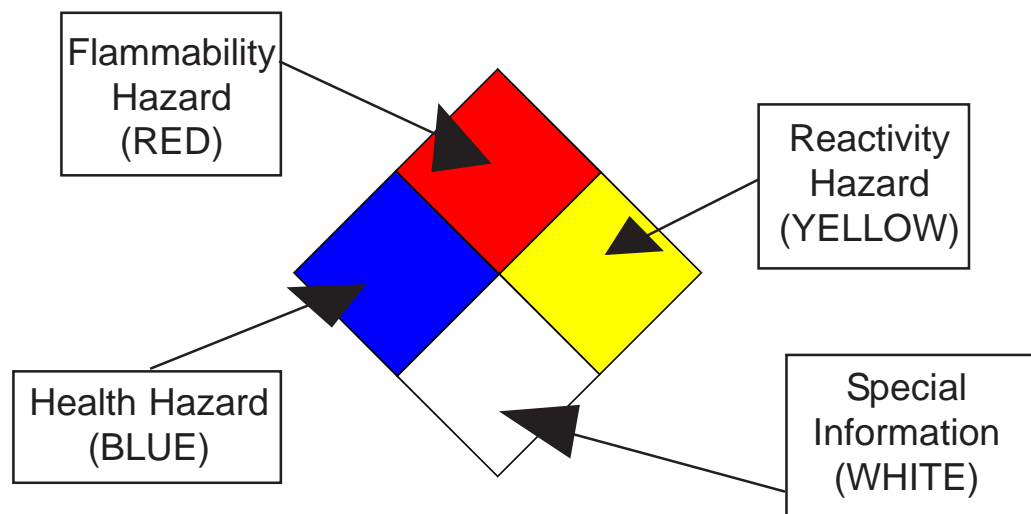


U.N. ID Number

- The four-digit number must also be on shipping papers and waste manifests.
- Use the yellow section of the DOT Book (North American Emergency Response Guidebook) to look up the chemical name of a substance with an ID number.

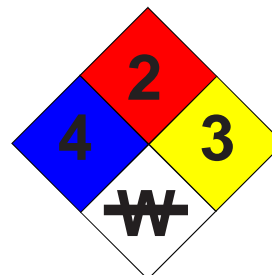
NFPA 704 Hazard Identification System Overview

NFPA 704 is a standardized system which uses numbers and color signs to define the basic hazards of special materials. Health, flammability, and reactivity are identified and rated on a scale of 0 (no hazard) to 4 (high hazard) depending on the degree of hazard present.



The ratings for individual chemicals can be found in the NFPA *Fire Protection Guide on Hazardous Materials*. Other references, such as the U.S. Coast Guard manual *CHRIS Volume 2* and the National Safety Council's *Fundamentals of Industrial Hygiene* contain the NFPA ratings for specific chemicals.

For example, the chemical represented here has a health hazard of “4”, a flammability hazard of “2”, a reactivity hazard of “3”, and it is water reactive.



Checklist To Evaluate Your Plant's Hazard Communication Program

The following checklist is adapted from the list Cal/OSHA inspectors use to evaluate the plant's Hazard Communication Program.

Review of the Written Plan:

- Describe how in-plant labeling will be accomplished. (5194 e 1)
- Who is responsible for making and maintaining labels?
- Describe the labeling system used.

- Describe how MSDS requirements will be met? (5194 e 1)**
- Who is responsible for the MSDS program?
- How will MSDSs be obtained and kept for every product used?
- How will MSDSs be made accessible to employees?
- How will MSDSs be checked for omissions?
- How are missing MSDSs requested from vendors?
- How will Cal/OSHA be notified if vendor fails to respond?

- Describe how employees are trained.**
- Who is responsible for training?
- Describe your initial training plan.
- Update (on new hazards) and refresher training plans.
- A complete list of on-site hazardous substances.
- How will employees be informed of hazards of non-routine tasks and hazards of unlabeled pipes?

Implementing the Plan:

- How will contractors be informed of hazardous substances?
- The written program is available upon request to workers and Cal/OSHA?

- Labels:** (5194 f) Each container is labeled with product identity and hazard warnings.
- Labels are displayed and legible on all in-plant containers.

- MSDS:** (5194 g) Plant has MSDS for each hazardous substances.
- MSDS are accessible to all employees.

- Training:** (5194 h) Explains what an MSDS is and info it contains.
- MSDS contents for each substance or class of substances used.
- Explain and make available written Hazard Communication Program.
- Location of work areas using hazardous substances and specific hazards and precautions.
- Methods used to observe and detect hazards.
- Details on plant labeling and MSDS system.



Hazard Evaluation and Control



Outline

1. Exposure Guidelines
 - Threshold Limit Values (TLV)
 - Permissible Exposure Limit (PEL)
 - Where Do They Come From?
2. Three Types of Exposure Limits
 - Time Weighted Average (TWA)
 - Short-Term Exposure Limit (STEL)
 - Immediately Dangerous to Life and Health (IDLH)
3. Recognition, Evaluation, and Control
4. Monitoring
5. Access to Monitoring Results
6. Hazard Control

Objectives

Participants will be able to:

1. Define what is “Permissible Exposure Limit” or “PEL”.
2. Define what is a “Threshold Limit Value” or “TLV”.
3. Recognize and prioritize three approaches to controlling exposures:
 - a. Engineering Controls
 - b. Administrative Controls
 - c. Personal Protective Equipment (PPE)
4. Identify four types of monitoring equipment, and describe situations on which to use each one:
 - a. Detector tubes
 - b. Continuous instruments
 - c. Direct reading instruments
 - d. Integrated air monitors
5. Evaluate a sample air monitoring report.

Exposure Guidelines

TLV: Threshold Limit Values

- set by ACGIH (American Conference of Governmental Industrial Hygienist)
- used by industrial hygienist in recommending controls for workplace exposures
- not intended to define “safe” and “unsafe”
- not legally enforceable
- updated yearly

PEL: Permissible Exposure Limit

- set by OSHA (Occupational Safety and Health Administration)
- legally enforceable standards
- usually less stringent than current TLVs
- updated periodically, most less often than TLVs

Where Do They Come From?

ACGIH TLVs (recommended guidelines)

Beginning in the 1920s, industrial hygienists used-Maximum Allowable Concentrations (MACs) as guidelines in evaluating worker exposures to hazardous substances. These guidelines were the first attempt at limiting workers’ exposures to specific chemicals. In 1938, the American Conference of Governmental Industrial hygienists who were mostly affiliated with government agencies. the ACGIH eventually assembled the lists of MACs and used them as the basis for developing what are now called Threshold Limit Values (TLVs).

The TLVs are air concentrations of chemicals used by industrial hygienists in recommending controls for workplace exposures. They are based primarily on

animal research and on the limits of measuring and control technologies. They were not intended to define the boundary between “safe” and “unsafe” exposures, and are not legally enforceable. The TLV list is updated yearly.

OSHA PELs (legal standards)

The Occupational Safety and Health Administration (OSHA) has set “permissible exposure limits” (PEL’s). These are legally enforceable standards for worker exposures to chemicals found in their workplace. When the Occupational Safety and Health Act (OSHAct) was passed in 1970, OSHA was charged with setting the legally enforceable standards for workplace health and safety. These standards were to be set by a specific rulemaking process laid out in the Act.

However, in order to provide for early enforcement, Congress gave OSHA the authority to establish an initial set of legal standards without going through the rulemaking process. OSHA used this authority to adopt as standards a number of guidelines set forth by organizations such as the National Fire Protection Association (NFPA), the American National Standards Institute (ANSI), and ACGIH.

In 1971, OSHA used the 1968 list of TLVs for its PEL’s. These have been updated periodically, but this must be done through the rulemaking process, which can take years to complete. TLV’s are updated more easily than legal PEL’s, consequently, PELs are generally outdated and less stringent than current TLVs.

The PEL is OSHA’s version of the maximum permitted 8 Hour Time Weighted Average (TWA) concentration of an airborne contaminant. The TWA can be determined by conducting integrated sampling of air monitoring during an 8 Hour work day.

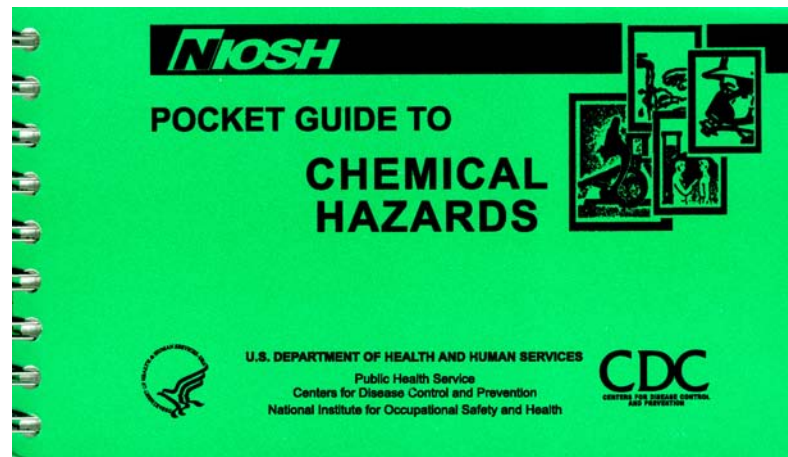
The NIOSH Pocket Guide to Chemical Hazards

The NIOSH Pocket Guide lists chemical-specific information for some 400 chemicals that have OSHA PELs. It is, therefore, not a comprehensive guide to all chemical hazards, but is a valuable source of information about some hazardous materials. It is a summary of work that NIOSH and OSHA completed as a joint effort.

The data in the Pocket Guide includes physical and chemical properties, exposure limits, health effects, and information about measuring and controlling exposures. The data comes from NIOSH criteria documents as well as other recognized documents in the fields of industrial hygiene, occupational medicine, toxicology and analytical chemistry.

All of this information is abbreviated in an effort to reduce the size of the book, but abbreviations are defined in Tables at the beginning of the Guide. Chemicals are listed alphabetically in the Guide, but are also cross-referenced by synonyms and Chemical Abstract Service Numbers (CAS#s) in the back of the book. The recommendations for respiratory and personal protection are NIOSH recommendations and are not legally enforceable, but they may be the most appropriate.

Most specific descriptions of each column of information used in the Guide are given in section III of the Pocket Guide entitled “How to Use This Pocket Guide.”

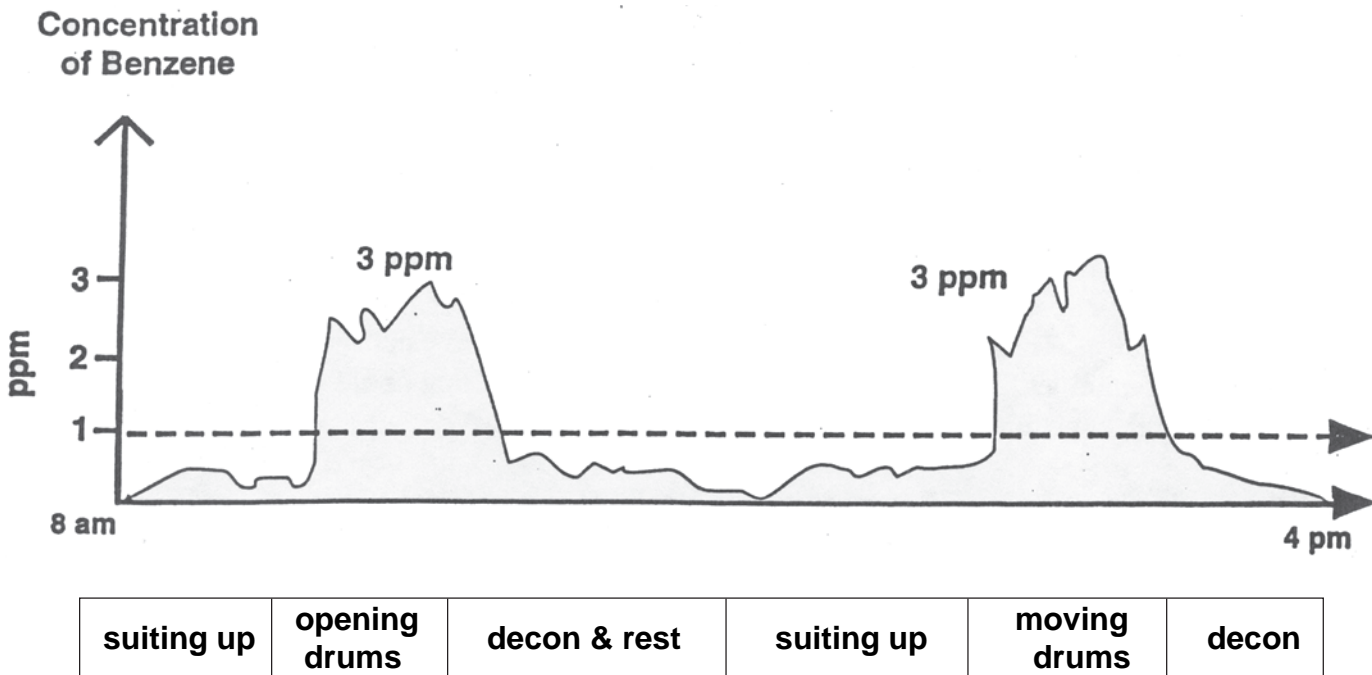


Three Types of Exposure Limits

Time Weighted Average (TWA)

Most exposure guidelines are 8-hour TWAs, which are an average exposure over an eight-hour work day. These exposure guidelines are intended to minimize the effects of repeated regular exposure to a substance over a working lifetime. It is permissible to be exposed to concentrations above the limit, provided any periods of higher exposure are equaled by periods below the limit during the same work day. This means that it would be legally permissible for a worker to be exposed to a concentration of twice the PEL (TWA) for four hours as long as there was no exposure during the other four hours of the work day.

Consider the following graph of a worker's exposure to benzene while working on a hazardous waste site. Benzene's PEL is 1 ppm. You can see that during certain periods of the day the worker's exposure is as high as 3 ppm. But is this an exposure above the PEL for benzene? The calculations follow on the next page.



Source: The next three pages are from *Basic Health and Safety Course for Hazardous Waste Personnel*, the New England Consortium, 1997.

The benzene levels are: 3 ppm for one hour in the morning and 3 ppm for one hour in the afternoon and essentially zero at all other times. The 8-hour time weighted average exposure for someone working on the waste site would be calculated in the following way.

$$\text{TWA} = \frac{(3\text{ppm} \times 1\text{hr}) + (3\text{ppm} \times 1\text{hr}) + (0\text{ppm} \times 6\text{hrs})}{8 \text{ hours}}$$

$$\frac{3 + 3 + 0}{8} = \frac{6}{8} = 0.75 \text{ ppm}$$

So, although the worker was exposed to 3 ppm for part of the day, the time weighted average (TWA) falls below the permissible exposure limit of 1 ppm. Therefore, the worker has not been exposed above the 8-hour TWA PEL.

Short-Term Exposure Limit (STEL)

As we have noted, the 8-hour TWA can be exceeded for part of the day provided the average daily dose does not go over the TWA. Some chemicals have limits for shorter exposures. These short-term exposure limits (STELs) are usually for an average of 15 minutes. They are meant to prevent acute effects that could occur as a result of high exposures over a short duration.

For example, the OSHA STEL for benzene is 5 ppm. Thus, in the above example, if a worker were exposed to a brief “spike” of exposure while opening a drum-say 10 ppm for 15 minutes-s/he would be exposed above the OSHA limit because of the STEL, even though the worker’s 8-hour TWA remained below the PEL.

Ceiling Limits (C)

Some substances, usually those with fast-acting toxic effects, have been assigned Ceiling Limits in addition to, or instead of, 8-hour TWAs and/or STELs. This is a concentration that should never be exceeded. Therefore, if one of the workers on the waste site described above had to stand behind a forklift where the carbon monoxide concentration was 300 ppm for just a couple of seconds, his exposure would have exceeded NIOSH’s ceiling limit of 200 ppm.

What Is Immediately Dangerous to Life and Health (IDLH)?

IDLH values are the maximum concentration of a chemical from which one could escape within 30 minutes without irreversible health effects. This includes any severe eye or respiratory irritation which could prevent escape without permanent injury. The IDLH guideline is used in the decision-making process for respirator selection developed by NIOSH/OSHA, but is not a legally enforceable standard (see Chapter 6).

The IDLH is important for site workers to know, particularly when responding to a spill in a confined space or low-lying area where vapors may accumulate. A site that has exposures above the IDLH requires maximum protective measures.

What Is the Weakness of This System?

All exposure limits are best used as guidelines. Thinking of them as the maximum exposure that is safe can get you into trouble. Instead, use them as a way of deciding the types of controls to use. If a control mechanism puts you close to the exposure limit, then a better control may be needed. That may be difficult to do on some waste sites, but protecting the health and safety of the people working to clean the site is the most important thing.

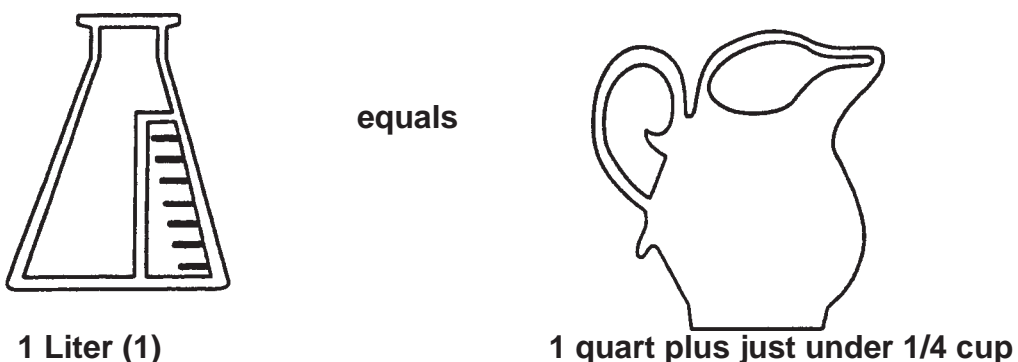
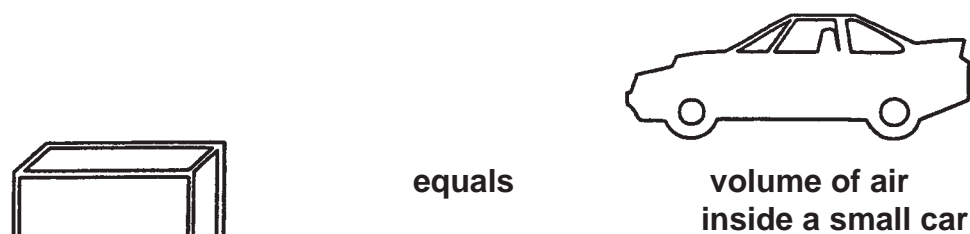
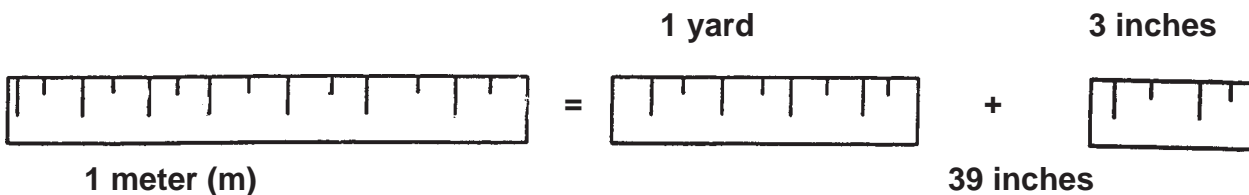
The workers in the TWA example, on page 17, were never exposed to benzene above the legal limit. If they have that same exposure regularly for many months or years, will they stay healthy? Benzene can cause cancer and some experts say there is no safe dose for a carcinogen (see appendix A in your NIOSH Pocket Guide).

What about the worker behind the forklift? What is the likelihood that an industrial hygienist or a government inspector would be there taking a sample to find out the exposure limit was exceeded? Carbon monoxide can poison and even kill you. How would that worker know that there is too much carbon monoxide in the air s/he is breathing? A big problem with chemical exposure limits is that you rarely know if they are being exceeded.

Measuring Volume

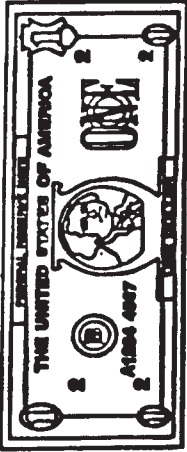
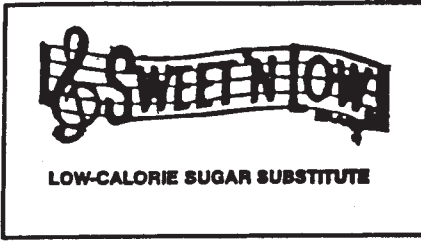
Here are some explanations for the numbers used (note that for most substances, mg/m^3 can be converted into ppm).

mg/m^3 — This is milligrams of substance per cubic meter of air. The term is most commonly used for measuring concentrations of dusts, metal fumes or other particles in the air.



Measuring Weight

mg/kg — This is milligrams of substance per kilogram of body weight. It is used generally to measure toxic chemicals we swallow. A kilogram is a metric unit weighing about 2.2 U.S. pounds.


1 gram (g) =  or 

weight of a dollar bill

weight of 1 packet of Sweet 'N Low

1 thousand milligrams (mg) = 1 gram

1 million micrograms (μg) = 1 gram

454 grams = 

1 pound

Solving Exposure Problems

It's as easy as 1, 2, 3 . . .

1. Recognition

Focus on it . . .



2. Evaluation

Check it out . . .



3. Control

. . . And fix it!

General Principles: Recognition, Evaluation, and Control

It's as easy as 1,2,3...

Occupational health problems can be solved by a three step approach:

- 1) Recognition of the problem
- 2) Evaluation of the environment factors
- 3) Application of control measures

1. RECOGNITION

The first step in recognizing potential problem areas is to become familiar with the particular operations in the plant. Study the process and the equipment used. Review process flow sheets and previous industrial hygiene surveys.

2. EVALUATION

Conduct a walkthrough survey to note all aspects of the work operation. Then perform air monitoring to measure the levels of exposure to each toxic substance. Finally, compare the air monitoring results to the existing standards (PELs and TLVs), and interpret the results to take into account the specific workers and work process involved.

3. CONTROL

Now the problem must be fixed. For each hazardous material, the amount of exposure to each worker must be reduced to below the acceptable health standard. The 3 types of controls are:

- a) **Engineering controls**—specific changes in the work process and physical work environment. These include: substitute a safer chemical, redesign the process, enclose the process, mechanize the process, erect barriers or dikes, local exhaust ventilation, general ventilation, and housekeeping.
- b) **Administrative controls**—reduce the amount of time that each worker is exposed to a chemical by changing his or her work assignments.
- c) **Personal protection**—require each worker to wear a respirator, protective clothing, goggles, earplugs, or other protective device. *Note: Personal Protective Equipment should always be used only as a LAST RESORT!*

Air Monitoring

Purposes

- Identify and quantify airborne contaminants
- Identify potentially life-threatening situations
- Determine whether protective equipment and controls are needed
- Revise health and safety controls as needed based on monitoring results
- Monitor compliance with health and safety standards

Conditions Monitored on Hazardous Waste Sites

- O₂ Deficiency
- IDLH concentrations of airborne contaminants
- potential radiation hazards
- confined spaces, excavations, trenches
- drums, other containers
- new work locations
- new work operations before initial entry into exclusion zone (start of each day)
- drilling
- liquid sampling
- drum opening



Important Aspects of Industrial Hygiene Monitoring Include

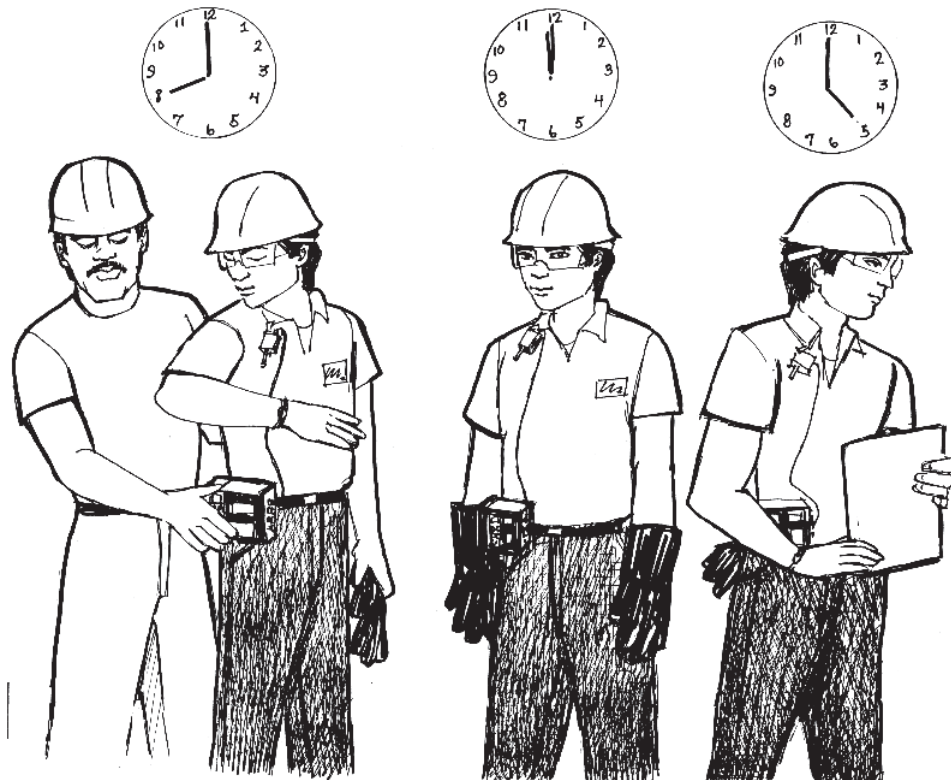
- All forms of chemicals (gas, vapors, liquids, solids, fumes) can be monitored
- Each chemical has its own method for monitoring that requires specific equipment-not all chemical monitoring is done the same way
- The equipment used to monitor chemical exposures must be regularly calibrated and maintained in good working order
- Samples can be taken for different lengths of time: short-term (15 minute) samples and full-shift (8 hours or more) samples
- Different types of samples can be taken:
 - “area” samples of the exposures in a given area or work station, and
 - “personal breathing-zone” samples for specific workers wearing the monitoring equipment
- Different “strategies” for sampling can be done:
 - “random” samples of all job tasks or operations, or
 - “worst-case” samples of the worst job tasks or operation in the department

Measurements and Personal Monitoring

Factory inspectors (government, insurance company, “monitors” of company “codes of conduct”) may or may not conduct industrial hygiene monitoring during their inspections of the plant. However, the **employer should have conducted** this kind of monitoring to determine the level of hazards faced by the workers, and to control the hazards that are found. It is important to understand how monitoring can be done and what the results of the monitoring means.

There are two types of monitoring that can be done:

- (1) immediate measurements of the worker exposure at the moment the test is done; and
- (2) full-shift measurements of the work exposure over the entire length of the shift (8 hours, 10 hours, 12 hours or whatever length the shift is).

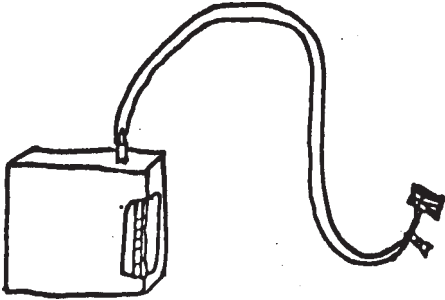

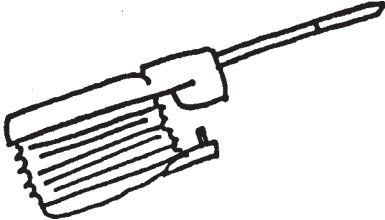
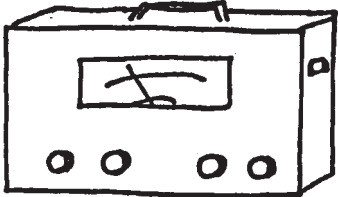


Immediate monitoring is done using “direct-reading” instruments. **Full shift monitoring** is done using various types of air-sampling pumps and other equipment. Examples of hazards and monitoring equipment are:

Hazard	Immediate “direct-reading” equipment	“Full-shift” monitoring equipment
Chemicals	Detector tubes; gas meters, vapor meters	Air pumps, tubes and filters of many different types
Noise	Sound Level Meters	Personal dosimeters
Heat stress	“WBGT” meters	
Ventilation	Smoke tubes, flow rate meters of different types	

The evaluation of airborne chemical hazards is complicated and it requires trained personnel to do the monitoring correctly so the results actually represent the chemical exposures of the workers. However, this kind of monitoring **can be done** and it is the responsibility of the employer to do enough monitoring to know what hazards the workers are exposed to on the job. the employer needs to hire trained and experienced personnel to perform the monitoring according to government regulations and the “best practices” of the industrial hygiene profession.

Types of Instruments Used To Monitor Airborne Contaminants

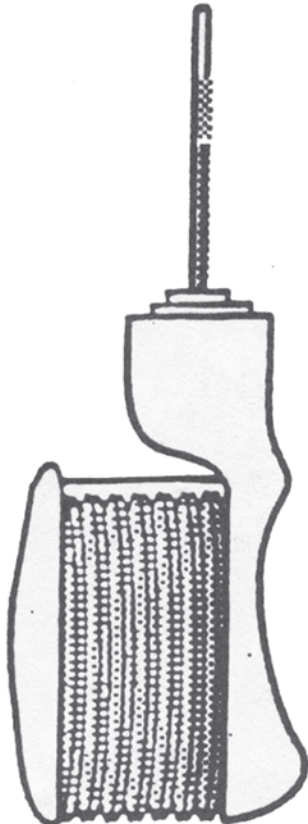
	Personal Integrated Monitoring	Area Instantaneous Monitoring
Purpose	To measure 8-hour TWA air concentrations, representing actual worker exposures	To measure actual air concentrations at specific locations and exact times
Limitations and Disadvantages	<ul style="list-style-type: none"> • Time consuming to plan and do the monitoring • For some methods, equipment and laboratory analysis are costly • Must wait weeks for results 	<ul style="list-style-type: none"> • Some methods are imprecise • Does not measure personal exposures over entire workshift or entire period of exposure
Examples	<p>Personal Air Sampling Pumps</p>  <p>Diffusion Badges</p> 	<p>Colorimetric Detector Tubes</p>  <p>Direct Reading Instruments</p> 

Monitoring

Colorimetric Detector Tubes (Dräger, MSA)

Use:

- To samples gas or vapor concentration in any workspace.



Read-out:

- Percent concentration is indicated by color change or length of color stain.

Precautions:

- Not very accurate—within 25% of the real value at best.
- Pump must be checked for leaks and calibrated.
- Tubes have a limited lifetime, so the expiration date on the container should be checked before use.
- Results are affected by temperature and humidity.
- User must be trained in reading the scales on the tubes used.
- User must follow specific pump stroke requirements.

A colorimetric detector tube is a glass tube filled with a solid material gel that has been impregnated with an indicator chemical. When the detector tube is used the ends are broken off and the tube is inserted into a bellows or piston pump. An arrow on the tube indicates which end of the tube to insert into the pump orifice. A predetermined volume of air is pulled through the pump. The contaminant of interest reacts with the chemical in the tube. This reaction produces a stain in the tube with a length proportional to the concentration of the contaminant.

Personal Air Monitoring with Sampling Pumps

PERSONAL monitoring, as opposed to area monitoring:

The collection device is placed in the worker's breathing zone (a hemisphere in front of the shoulders with a radius of 6-9 inches), so that the data collected closely approximates the concentration inhaled.

COLLECTION of samples, as opposed to direct reading:

Sample collection does not provide an immediate measurement. Instead, sample collection devices collect a sample of air that is later analyzed or weighed at a laboratory.

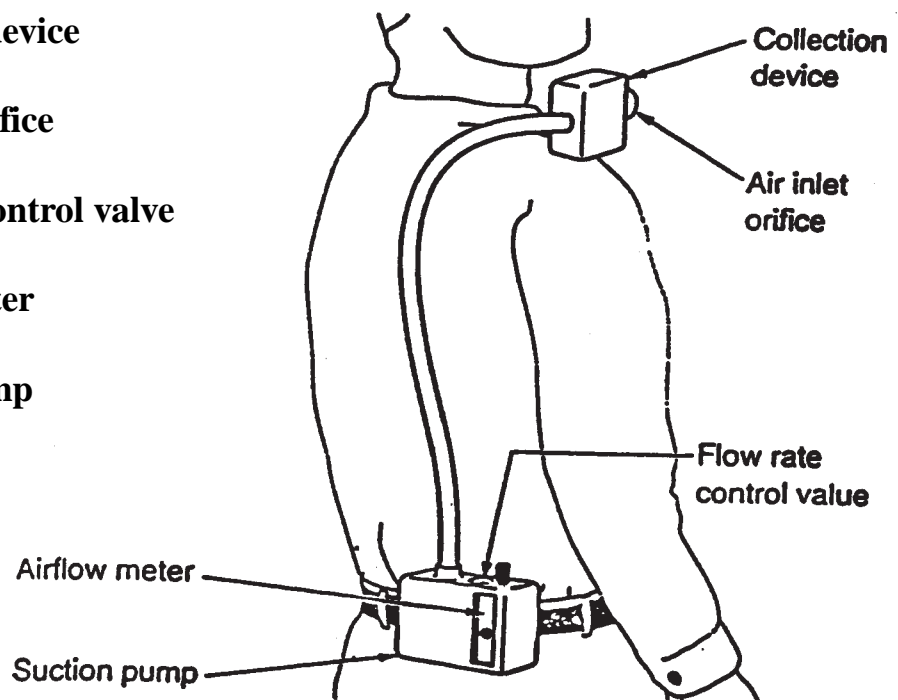
INTEGRATED sampling, as opposed to grab sampling:

Integrated sampling is used to measure a worker's 8-hour or 15-minute exposure. It integrates all of the various concentrations to which the worker has been exposed during the sampling period. The time-weighted-average concentration is equal to the mass of the contaminant collected divided by the volume of air that passed through the collection device:

TWA Concentration=(Mass of Contaminant Collected)/(Volume of Air Sampled)

SAMPLING SYSTEM consists of:

- **Collection device**
- **Air inlet orifice**
- **Flow rate control valve**
- **Airflow meter**
- **Suction pump**



Personal Air Monitoring with Sampling Pumps

Low Flow Sampling

Chemical	Flow Rate (liters/min.)	Collection Device
Acetone	0.01 - 0.2	Coconut shell charcoal tube
Acids, inorganic	0.2 - 0.5	Silica gel tube
Benzene	0.01 - 0.2	Coconut shell charcoal tube

High Flow Sampling

Chemical	Flow Rate (liters/min.)	Collection Device
Asbestos	0.5 - 16	Mixed cellulose ester filter cassette with cowl
Carbon black	1 - 2	Polyvinyl chloride filter
Isocyanates	1.0	Impinger (containing a solution of 1-(2-methoxyphenyl)-piperazine in toluene)
Nuisance dust	1 - 2	Polyvinyl chloride filter
Silica, crystalline, respirable	1.7 or 2.2	Cyclone and polyvinyl chloride filter

Evaluating Monitoring Reports

In evaluating any industrial hygiene monitoring report by the employer, industrial hygiene consultants or monitors of codes of conduct, the following questions should be asked:

- What was the hazard being monitored?
- Was the right equipment used and was that equipment calibrated?
- Was the sample time long enough to cover all possible worker exposures?
- Were all exposed workers (all job classifications, shifts) included in the sampling?
- Was a competent laboratory used to analyze the results?
- Were the monitoring results above or below the occupational exposure limit?



Monitoring Checklist

Yes No

- Were the people doing the monitoring trained and competent?

- Did they monitor for the right chemicals?
 - Chemicals used in all work processes?
 - Chemicals used in special tasks and cleanup jobs?
 - All the ingredients of chemical mixtures?

- Did they monitor in the right places?
 - In all work areas where there might be chemicals?
 - Near each worker’s breathing zone (nose and mouth)?

- Did they monitor at the right times?
 - During typical working conditions?
 - Over a full eight-hour shift?
 - Also during “worst case” conditions when levels might peak?
 - AT different times, on different days, when different jobs were being done?
 - During overtime periods?

- Did they use the right monitoring method?
 - Where possible, did they use the most accurate method—a sampling train to collect air samples or laboratory analysis?
 - If they used detector tubes, did they use the right tube for the chemical?
 - Were direct reading instruments properly checked and calibrated?
 - Does the employer keep records on the maintenance and calibration of instruments?
 - If detector tubes used, were they new and in good condition?
 - Were workers and the union given the results of the monitoring upon request, as required by OSHA?
 - Were workers and the union allowed to observe the monitoring when it was done?

“Right To Know” Laws

Access to Results of Monitoring in the Workplace

This regulation (GISO 3204) gives workers the right to see the results of any monitoring that has been done in the in the workplace.

For example, if an industrial hygienist has measured the quantity of chemicals in the air or the level of noise, workers and/or their union representative have the right to see the results of these tests.

By law, the employer must keep the results for 30 years. If workers are interested in the results of any test, they must request them in writing from the employer. The employer must respond to the request within 15 days.

SAMPLE LETTER Requesting Environmental Monitoring Information

Employer Name
Address of Employer
City, State, Zip

Date

Dear:

I am formally requesting a copy of all the environmental monitoring reports you have on file regarding:

Name of chemical: _____

Work area(s) monitored: _____

I use this chemical and/or work in this area during the routine course of my work I am making this request pursuant to Section 3204, Title 8 of the California Administrative Code. Your prompt attention to this matter is greatly appreciated.

Sincerely,

Name
Title (optional)
Address
City, State, Zip

What Is a Control?

A control is any device, procedure, piece of equipment, etc., that is used to keep vapors, fumes, dusts, etc., being generated by a work process, from getting into the air or onto the ground. The following is a list of the major controls used in the chemical industry in order of priority-beginning with the best controls. (We should always insist on the best controls, rather than settling for less adequate ones.)

1. Chemical Substitution:

Whenever possible, the best solution to a hazardous chemical exposure is to remove it entirely from the workplace to prevent all exposure. This is often possible as is demonstrated by the use of water-based paint instead of oil-based paints; and the use of insulation fluids other than those containing PCBs. Care must be taken to ensure that the substitute chemical is significantly safer than the original and that you are not just replacing one hazard with another.

2. Redesign (Change) the Process:

In many cases the danger or exposure hazards associated with a job are inherent in the set-up of the job or the organization of the work process itself. The process design can often be changed, resulting in potentially dramatic improvements in health and safety, without using PPE or even installing ventilation (refer to attached example). In fact, management will often redesign accommodate new technologies. So they should also be expected to review and change process design to minimize worker exposure.

3. Enclose the Process:

If the removal of the hazard is not possible, then the process should be enclosed. This should be investigated prior to a management decision to use respirators to control exposure. (In fact, this “idea” is contained in the OSHA regulations.) process enclosure keeps the contaminant out of the room air and effectively away from the worker. Plant areas, which require only occasional attention, can be very effectively controlled without interfering with operations. The following are some examples of enclosures:

- at sampling ports
- at spill or screening points
- sealing of ground-sewer connections
- sight boxed to see levels of materials inside vessels
- pneumatic conveying of dusty materials
- splash guards and hoods

These pages taken from OCAW-Labor Institute *Hazardous Waste Workbook*, July 1988.

4. Mechanize the Process:

Automating an operation, or phases of an operation, may be the best answer to a dangerous job. Of course management often wants to automate production processes to get rid of jobs. That is something the union must ensure does not happen if it pushes for process mechanization. Examples of where this type of control is and can be used abound in the chemical and nuclear industries. An example is pumps to handle solvents rather than manual measuring and dumping.

5. Barriers and Diking of Hazardous Processes:

This control is used where there are process or storage units which contain significant amounts of highly toxic materials and where a spill or leak could be potentially catastrophic in nature. Plant areas and processes, including storage tanks, should be evaluated for the potential to release chemicals into the environment (which also may be your own neighborhood or water supply). Containment barriers and collection systems should be designed and installed around these to prevent major exposure. However, these will not reduce worker exposures.

6. Local Exhaust Ventilation:

Toxic substances liberated into a work area from a process often can be effectively controlled by means of local exhaust ventilation applied at a point as close to the source of emission as possible and enclosing as much of the source of emission as possible. Ventilation design is of utmost importance in ensuring that the system functions effectively and removes contaminants. Major points to remember when looking at the local exhaust ventilation system:

- Is the opening of the ventilation system located right at the source of emission?
- Is there a hood or other component that encloses most or all of the emission source?
- Is the ventilation system opening large enough, and is the air flow fast enough, to actually “capture” the chemical?

7. General Ventilation:

This is the type of ventilation that comes from having doors or windows opened or having large ceiling or wall mounted exhaust fans, or having a ventilation system that circulates the air. This type of ventilation (also called dilution ventilation) is not applicable to the control of toxic materials because it does not stop them from being generated nor from getting into the room air. All it does is cause chemicals to be distributed throughout the work environment causing wider exposure problems. The main use for general ventilation is for office environments or in areas where

toxic materials are not used. In these areas it is used to circulate fresh air and control temperature for comfort.

8. Housekeeping:

Good housekeeping assists in keeping the work environment cleaner and prevents materials left on walking and working surfaces from getting into the air.

Housekeeping depends on two basic things; (1) Having adequate work time to allow for work area clean-up; and (2) being provided with the proper equipment to conduct work area clean-up. For instance, for powdered materials, vacuum cleaners instead of brooms should be used to control dusting and the use of air hoses to blow dust off of surfaces should not be allowed. Other examples include:

- curbed cement pads under pumps
- water and steam connections provided for area wash-down
- provisions made for adequate flushing of lines and equipment when brought down for repair or turn-around
- prompt clean-up of spills
- laying down of drop cloths



Medical Surveillance



Outline

1. Introduction

- What is medical surveillance?
- The importance of prevention.

2. Medical Surveillance Requirements for TSD Workers

- Who is covered
- When to have exams
- Content
- Notification
- Confidentiality

3. Parts of a Medical Evaluation

- The history is everything
- Physical examination
- Laboratory tests: medical and biological monitoring
- Limitations of lab tests

4. Employee Medical Rights and Responsibilities

- Choose your own doctor
- Get copies of your medical records
- Keep your own Occupational History Form of exposures and symptoms

Objectives

The goal of this section is to help ensure that your participation in your company's medical surveillance program can help prevent occupational illnesses and injuries.

Participants will be able to:

1. Describe what parts of the Hazwoper standard's medical surveillance provisions apply to them.

2. Describe the difference between primary, secondary and tertiary disease prevention as it relates to workplace medical surveillance.
3. Describe 3 steps they can take to receive proper medical diagnosis for work-related injuries and illnesses.
4. Describe how to get their own copies of job-related medical records.

Introduction

A. Workplace medical surveillance programs

- detect job-related health problems early enough to do something
- uncover their causes
- lead to actions which prevent occupational illnesses and injuries

B. Medical surveillance programs guard the health of:

- individuals by one-on-one medical evaluations
- the whole workforce by monitoring trends or patterns in the health of the group

These programs can check to see if workplace control measures are really preventing overexposure.

C. To make a medical surveillance program work requires:

- informed workers
- concerned and knowledgeable health care providers
- safety conscious employers

D. What occupational medical surveillance programs are **not**:

Other employer-sponsored medical programs—drug testing, employee assistance, health promotion—have their benefits, but are NOT a substitutes for medical surveillance programs for occupational illness and injuries.

Why Is Prevention Important?

Modern medicine has the ability to detect some diseases early (see first list below) and to cure and control them. But many of the serious occupational diseases we face cannot be treated at all (see second list). And even if tests are used to detect the disease early, by the time the disease shows up on the test, nothing can be done to reverse the disease. The truth is that we cannot count on medicine to protect us from exposure. Our goal must always be to stop the exposure before it starts the disease.



1. Diseases that can be detected early and can be cured or controlled:

Bladder Cancer
Colon Cancer
Asthma
Cotton Dust Disease

2. Diseases that usually cannot be reversed even when detected early:

Asbestosis
Lung Cancer
Leukemia
Silicosis
Black Lung Disease

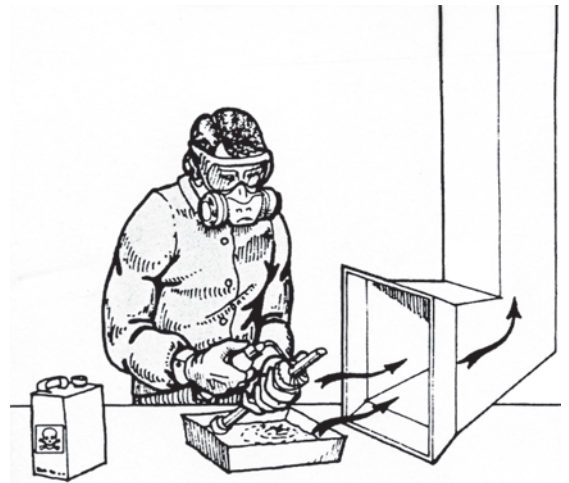
Sources: 1. William Rom, *Environmental and Occupational Medicine* (Boston: Little Brown and Company, 1983).
2. James Merchant, *Occupational Respiratory Disease* (U.S. Health and Human Services, September, 1986).

Medical Surveillance

3 Levels of Disease Prevention

1. Primary Prevention: eliminate exposure

Prevention of exposure in the first place. Examples are a protective barrier (e.g., engineering controls, work practices, and, to a lesser degree, protective clothing) between you and the toxic substance, encapsulation of the toxic substance, source reduction, etc. Most of us are familiar with vaccines (e.g., smallpox) as the most common form of primary prevention. We've essentially eradicated the existence of smallpox in the world, evidenced by the fact that newborn children are no longer given the vaccine.



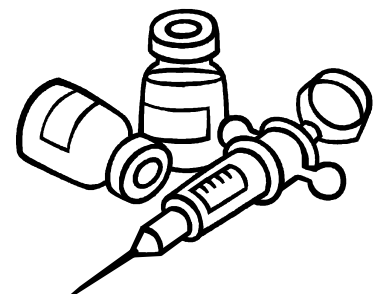
2. Secondary Prevention: early disease detection

Screening and early detection of effects before they become irreversible. Examples are blood screening for lead levels, testing for liver function abnormalities among solvent-exposed workers, etc.



3. Tertiary Prevention: treatment & rehabilitation

Treatment and rehabilitation of workers once a disease has already developed to prevent further complications and disability. Examples are surgery to remove a tumor, or drug therapy to stop a disease once it has begun.



Medical Surveillance Requirements for TSD Workers

If there are dangerous chemicals or certain other hazards on your job, OSHA requires your employer to set up a *medical surveillance program*. With a medical surveillance program, you get regular medical exams, paid for by your employer. There are special tests, depending on the specific hazards on your own job.

A medical surveillance program can:

- Detect job-related health problems
- Uncover their causes
- Help prevent injuries and illness

You should be in a medical surveillance program if you do any of these things:

- Respond to chemical emergencies and are likely to go near the source of the contamination.
- Are exposed to a toxic chemical at a high concentration for at least 30 days in a year. (A “high concentration” means an amount equal to OSHA’s Permissible Exposure Limit (PEL), or higher.
- Wear a respirator for at least 30 days in a year, even if you wear one only part of each day.

OSHA says you should get a medical exam:

- When you are first assigned to a job which requires medical surveillance.
- Every 12 months after the initial exam, unless a physician recommends more frequent exams.
- Whenever you tell your employer about signs and symptoms, which might be caused by job exposure to a hazardous substance.
- Whenever your employer finds out that you were exposed to a hazardous substance in an emergency situation without the proper personal protective equipment.
- When you are reassigned to a job not covered by the program, or you leave your job. This final exam is not legally required if you had a medical exam within the past six months.

Who Gives the Exam? Who Pays?

These medical exams must be conducted by a licensed physician, or under the physician's supervision. Some employers have their own medical staffs who give the exams. Others hire outside doctors or clinics.

The employer must pay for all exams. Also, you should not have to lose any of your own pay to take time off for an exam.

OSHA says that each exam should be given at a reasonable time and place.

At the exam, the physician is required to take your medical and work history. The physician must give special emphasis to symptoms which might be related to the hazardous substances found on your own job. The physician decides which tests should be done.

Not all doctors are qualified to evaluate job-related illnesses. A doctor who is Board Certified in Occupational Medicine should be in charge of the company's medical surveillance program. (Unfortunately, this is not legally required. Also, relatively few physicians are Board Certified in Occupational Medicine, and most company doctors are not.)

Your employer must give the physician information on:

- Your job duties
- Which hazardous substances are found on your job
- How much exposure you have had to them, or will have in the future
- What personal protective equipment (PPE) you use (respirators, chemical suits, etc.)
- Your previous medical exams (if the employer has the results, and they are not readily available to this doctor).

Also, the employer must give the physician a copy of OSHA's medical surveillance rules.

After the exam, the doctor must tell your employer about:

- Any medical conditions (work-related or not) which could put you at increased risk on the job
- Any recommendations for restricting your use of respirators or other personal protective equipment (PPE).

You are entitled to get the results of these medical tests. You have a right to a copy of any of your medical records which your company has. You can authorize the company to turn over your medical records to a physician of your choice.

Parts of a Medical Evaluation

The issue of medical monitoring tests is particularly difficult for hazardous waste workers. Because worker exposures are often low-level and chronic (effects are not seen immediately), it is difficult to relate specific exposures to a negative health outcome. Medical monitoring programs attempt to address this concern for hazardous waste workers. It is highly recommended that workers maintain their own records of all medical examinations and exposures. In addition, workers should be assertive when dealing with physicians to ensure adequate medical testing and treatment.

I. FOR ALL WORKERS:

The following medical testing procedures are recommended as a part of a preemployment examination for all hazardous waste workers. These same tests should be repeated periodically in an annual or biannual medical exam.

1. Medical History

- personal illness and chronic diseases
- family health problems
- reproductive history
- lifestyle (e.g., smoking, drug use, etc.)
- history of reaction to specific chemicals and drugs

2. Occupational History

Be certain that this is not neglected in place of a medical history—they are separate.

- descriptions of all jobs held
- work exposures
- symptoms or illnesses among other workers at previous jobs
- personal protective equipment used

3. Physical Examination

- complete system review (cardiovascular, pulmonary, and musculoskeletal)
- eyes, ears, nasopharynx, abdomen
- evaluation of susceptibility (obesity, smoking) to exposures and physical problems (heat stress, noise)

4. Laboratory Tests

- Hematocrit (Hct)—to exclude severely anemic individuals from heat stress respirator use
- Pulmonary Function Test
- Audiometry—if working in a high noise area
- Freeze a serum sample—to compare with future blood tests

II. FOR WORKERS USING RESPIRATORS:

(Add the following to the above list):

1. Chest X-Ray (approximately every 3 years)
(Chest films should be read by a certified “B” reader)
2. Electrocardiogram (EKG)
3. Treadmill (if using PPE Levels A or B and/or if heat stress is a possibility)

III. FOR WORKERS IN EXTREME HEAT:

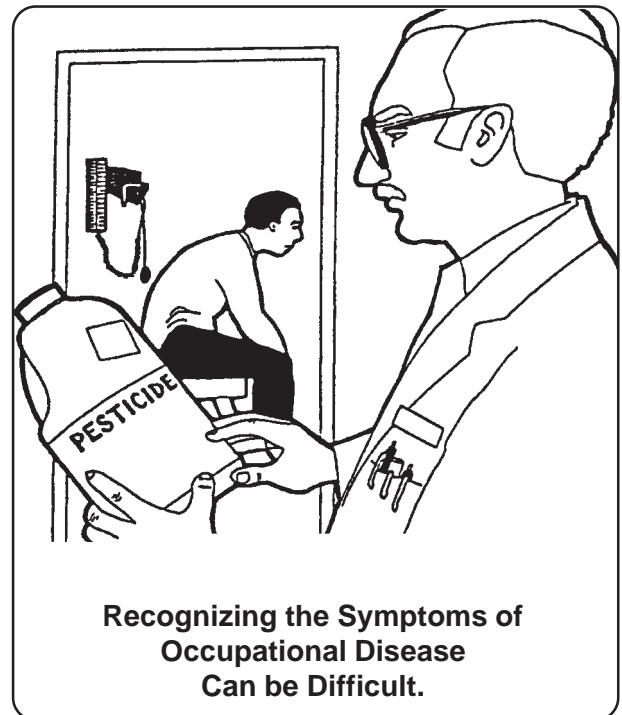
1. Treadmill (if over age 40)
2. Hematocrit

The Down Side of Lab Tests in Occupational Medicine

1. Few tests are sensitive; many don't detect problems until it is too late.
2. Few tests are specific; many other diseases unrelated to work place hazards can cause the same abnormalities.
3. Few tests have been fully evaluated for their reliability and validity in detecting occupational disease.
4. Some organ systems have no specific test to assess the impact of a workplace hazard.
5. All tests require selection, performance, and interpretation by skilled professionals.

Limitations of Medical Surveillance Programs

1. It is secondary, not primary, prevention!
2. Available tests may be invasive, expensive, potentially harmful, and insensitive.
3. Each program depends upon the proper selection, performance, and interpretation of medical tests by qualified and trained personnel.
4. Each program depends on the correct assessment of the types of exposures which workers are likely to receive. If you are not looking for a specific biologic change, effect, or outcome, it is likely to be missed in a "shotgun" screening approach.
5. Analysis of group results is often lacking, but such analysis is key to early detection of effects.
6. It has a high potential for abuse (e.g., discrimination, breaches of confidentiality), and/or mixing with other less ethical practices, such as random drug testing.



Some Tests Used in Medical Surveillance

Besides doing these tests, the doctor should also take a medical history and give you a general physical examination.

Part of body	Test	Could Detect
nose, mouth, throat	general physical exam	chemical irritation
skin	general physical exam	chemical irritation
eyes	visual acuity	vision loss or change
ears	audiogram	hearing loss caused by noise
lungs	breathing tests (including spirometry)	-obstructive lung disease (like emphysema) -restrictive lung disease (like asbestosis or silicosis) -fitness for respirator use
lungs	chest x-rays	-lung cancer -asbestos-related diseases
heart	electrocardiogram (EKG) or exercise testing	-rhythm abnormalities -coronary artery disease
kidneys	kidney function tests (blood sample) urinalysis (urine sample)	how well the kidneys get rid of toxins and wastes kidney disease or damage
liver	liver function tests (blood sample)	-how well the liver works -hepatitis -liver disease or damage
digestive system	hemoccult (stool sample)	bleeding in the intestine may be due to polyps or cancer
blood	CBC (complete blood count)	-anemia -leukemia -infection
nervous system (peripheral)	nerve conduction studies	nerve damage
nervous system (central)	neuropsychologic testing	-memory loss -personality change
reproductive system	-semen analysis (semen sample) -pregnancy test (blood or urine sample)	-pregnancy -increased hazard from some chemicals due to pregnancy

Source: International Chemical Workers Union, *Hazardous Waste Worker Training Manual*, January 1993

Employee Medical Rights and Responsibilities

Tips When Choosing an Occupational Health Doctor

When you are hurt on the job, who do you go to for care? Most likely it's your family doctor. Yet most family doctors know little about diagnosing and treating work-related injuries. Not surprising, given that the average doctor only spends *4 hours* in the *8 years* of physician training learning about occupational medicine.

In contrast, a doctor with special certification in Occupational Medicine spends at least two years learning this field—from respiratory diseases and cancers caused by chemicals to noise-induced hearing loss and musculo-skeletal disorders such as carpal tunnel syndrome or back pain.

Who would you want performing heart surgery: a cardiologist or your family doctor? The same reasoning should apply when choosing a doctor to detect and treat job-related injuries and illnesses. You should see a doctor with special training in “Occupational Medicine.”

How can you make sure that the doctor treating you knows as much as he or she should about your illness? Here are a few tips:

1. Check the list on the next page to see if the clinic or doctor is a member of the Association of Occupational and Environmental Health Clinics—AOEC.
2. Find out if the doctor is board-certified in occupational medicine. You can find this out by asking or by checking it on the Internet at www.certifieddoctor.org.
3. Talk to your co-workers and your local union leadership for recommendations (or suggestions of who to avoid).
4. Ask your family doctor for a recommendation of a doctor who has experience treating your particular illness or injury.
5. Workers' compensation lawyers can be a referral source for doctors. If you have a work-related injury or illness, you will need a doctor with more than good medical skills; you need someone who knows how your state's workers' compensation system works.
6. Ask the doctor if he or she works for the company in any way. (This may be a conflict of interest in a workers' compensation case.)

Bottom line: Pick a doctor who

- is trained in diagnosing work-related injuries and illnesses
- is a good listener: asks questions about your work environment and symptoms
- you feel comfortable with.

Source: Adapted from fact sheet by the PACE Resource Center, 1999.

Northern California Occupational Health Clinics

The following three University-based clinics specialize in the treatment of occupational health conditions. All are members of the Association of Occupational and Environmental Clinics (AOEC) and have doctors Board-Certified in Occupational Medicine.

General services provided include:

- diagnosis and treatment
- medical screening
- asbestos surveillance
- industrial hygiene evaluations
- medical surveillance
- medical-legal evaluations
- pre-placement evaluations
- health education

Most common diagnoses seen at the clinics:

Asbestos Disease, Contact Dermatitis, Asthma, Lead Exposure, Musculoskeletal Conditions, Solvent Exposures, Pesticide Exposures and Indoor Air Pollution

Bay Area:

UCSF Occupational Health Services

Call: 415-885-7580

Fax: 415-771-4472

University of California at San Francisco/SFGH

Call: 415-206-4320

Fax: 415-206-8949

Sacramento:

University of California at Davis (clinic in Sacramento)

Call: 916-734-2715

SAMPLE LETTER

Requesting Results of Medical Tests

Employer Name

Date

Address of Employer

City, State, Zip

Dear:

With this letter, I am formally requesting a copy of my medical records and tests.

I am making this request pursuant to OSHA: 29 CFR 1910.120, and Section 3204, Title 8 of the California Administrative Code. Your prompt attention to this matter is greatly appreciated.

Sincerely,

Name

Title (optional)

Address

City, State, Zip

Medical Surveillance Worksheet

1. The following individuals must be enrolled in a medical surveillance program according to the OSHA Standard, 29 CFR 1910.120, (check all that apply).

- A. Workers exposed at or above the PEL for 30 days or more per year (regardless of respirator use)
- B. Member of HAZMAT Teams.
- C. Workers who are injured due to overexposure from an emergency incident involving hazardous substances.
- D. Workers exposed at or above the PEL for less than 30 days per year (regardless of respirator use).
- E. Workers who wear a respirator for 30 days or more per year.
- F. All of the above.

2. According to the OSHA Standard, workers enrolled in medical surveillance programs must have medical examinations made available at the following times (check all that apply):

- A. Prior to assignment.
- B. Prior to training.
- C. Prior to appointment.
- D. Annually.
- E. At termination of employment or reassignment.
- F. As soon as possible following notification by the worker that s/he has developed signs or symptoms indicating possible overexposure to hazardous substances, or that the worker has been injured or exposed above the PEL in an emergency situation.

- G. At more frequent times, if the examining physician determines this necessary.
- H. All of the above.

3. Is it legal for a worker enrolled in a program of medical surveillance to have a medical exam less frequently than every year?

- YES NO

4. The content of the medical examinations is to be determined by (check all that apply):

- A. The worker.
- B. The employer.
- C. The attending physician.
- D. OSHA.
- E. All of the above.

5. Can an employer require that a worker take a pre-placement medical examination before s/he is hired?

- YES NO

6. The physician performing the medical examinations must have the following credential (check all that apply):

- A. A license to practice medicine.
- B. A license to practice medicine along with experience in occupational safety and health.
- C. A license to practice medicine along with Board Certification in Occupational Health.

7. Examinations are to occur on:

- A. Company time.
- B. The worker's time.
- C. Howdy Doody time.

8. Who is to pay for the medical examinations?

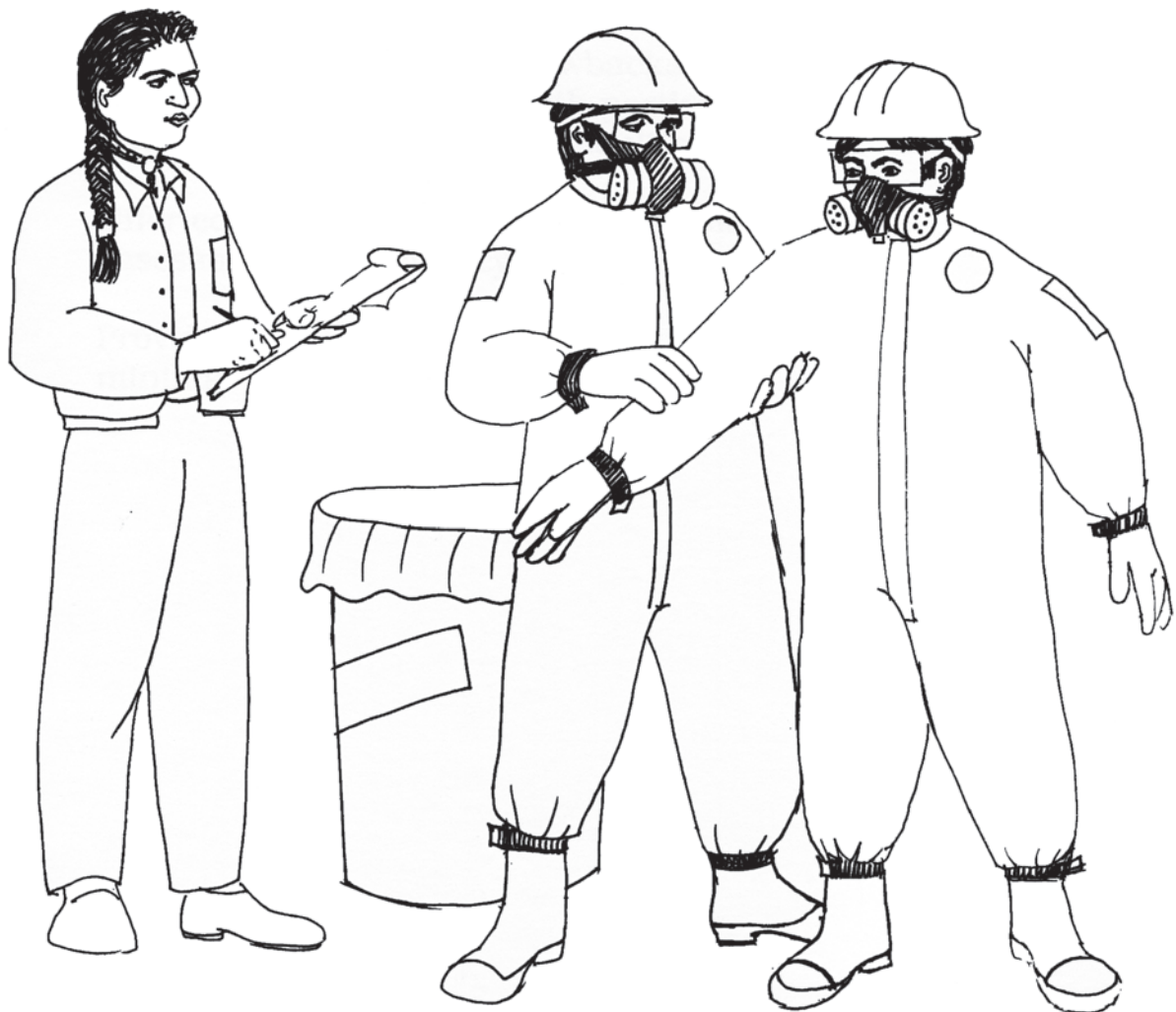
- A. The worker.
- B. The company.
- C. The worker and the company share the cost.

9. Previous to the administration of any medical examinations to the worker, the employer is required to provide the examining physician with the following information (check all that apply):

- A. A copy of the OSHA Hazardous Waste Standard.
- B. A description of the worker's duties.
- C. The worker's exposure levels or anticipated exposure levels to hazardous chemicals.
- D. A description of any Personal Protective Equipment used by the worker.
- E. Information from previous medical examinations of the worker which is not readily available to the examining physician.
- F. Information required by the Respiratory Protection Standard (29 CFR 1910.134)



Working Safely in Confined Spaces



Outline

1. Identifying Confined Spaces

- Limited openings for entry and exit
- Unfavorable natural ventilation
- Not designed for continuous worker occupancy

2. The Hazards of Entering and Working in Confined Spaces

- Oxygen deficient atmospheres
- Flammable atmospheres
- Toxic atmospheres
- General physical hazards
- Standby and rescue

3. Methods for Safe Confined Space Entry

- Written entry permit
- Air monitoring
- Ventilation
- Isolation (Lookout/Tagout)
- Respiratory protection
- Rescue plan

4. The Importance of Permits in Confined Space Work

- What information should be on a work permit?
- Review of a sample permit

5. The Cal/OSHA Standard

- How does the standard protect confined space workers?

Objectives

Participants will be able to:

1. Define the elements of confined spaces.
2. Describe ways confined spaces present hazardous occupational conditions.
3. Describe preliminary steps for safe entry.
4. Identify the protection OSHA offers to confined space workers.
5. List components of a good confined spaces training program.

Confined Spaces

As many as 1.6 million U.S. workers are required to enter confined spaces, such as tanks or trenches, each year to do construction, maintenance, or repair work. More than 50 of these workers die and 5,000 of them are injured each year. *60% of these deaths are rescuers.* These deaths and injuries can be prevented simply by recognizing the hazards and implementing proper controls before entry.

OSHA has promulgated a standard for confined spaces. It requires the development of entry permit systems whenever workers will be entering a confined space. The standard does not apply to construction workers unless they are conducting activities that might occur in general industry, such as cutting inside a tank. The requirements of the standard suggest safety-oriented practice for all confined space entry. This chapter describes the hazards of confined spaces and the means for controlling those hazards as they are laid out by OSHA.

What Is a Confined Space?

A confined space is defined by OSHA as a space that:

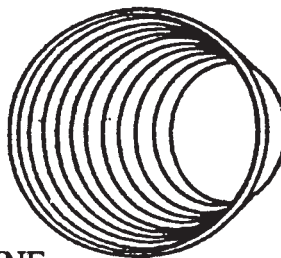
- Is large enough for a worker to enter and perform work;
- Has limited or restricted entrances or exits; and
- Is not designed for continuous employee occupancy.

Some examples:

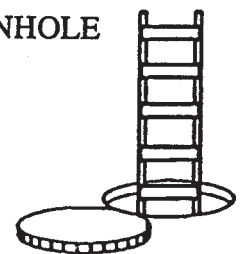
DIGESTER



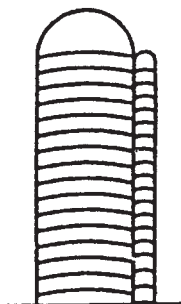
PIPELINE



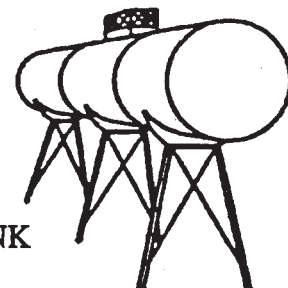
MANHOLE



SILO



HOLDING TANK



from: *Basic Health and Safety Course for Hazardous Waste Site Personnel*, New England Consortium.

Definition of a Confined Space

The National Institute for Occupational Safety and Health (NIOSH) defines a confined space as an area having one or more of the following characteristics:

1. Poor natural ventilation:

Air in a confined space does not move in and out freely. Therefore, the atmosphere inside a confined space can be very different from the atmosphere outside.

Dangerous gases may be trapped inside a confined space, especially if the space is used to store or process chemical or organic materials, which may decompose.



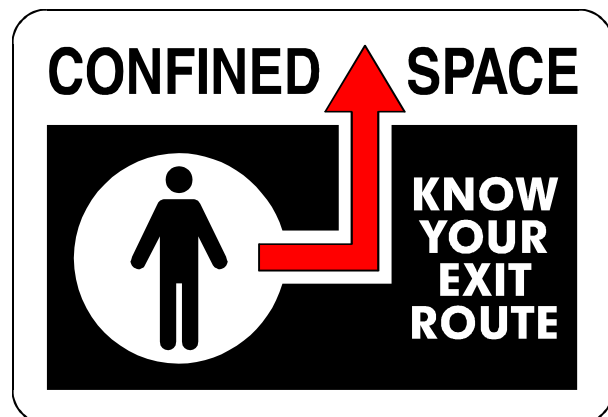
There may not be enough **oxygen** inside a confined space to support life. Or, the air could have so much oxygen that it is likely to increase the chance of fire or explosion if a source of ignition is present (a cigarette, for example).

2. Limited opening for entry and exit:

Confined space openings are usually small in size. For example, they may be as small as 18 inches in diameter. They are difficult to move through easily. Small openings make it difficult to get work equipment in or out of the spaces.

It is also difficult to get protective equipment, such as respirators, and life-saving equipment into these spaces.

In some cases, confined space openings may be very large, for example open-topped containers such as tanks or degreasers. You may have to use ladders, hoists, or other equipment to enter or exit these spaces. Escape from such areas may be very difficult in an emergency.



3. Not designed for continuous worker occupancy:

Most confined spaces are not designed for workers to enter and work in on a routine basis. They are designed to store a product, enclose materials and processes, or transport products.

Therefore, occasional worker entry for inspection, maintenance, repair, cleanup, or similar tasks is often difficult and dangerous due to chemical or physical hazards within the space.



Cal/OSHA however, defines a confined space as an area with poor ventilation and limited openings for entry and exit.

A confined space in the workplace may have a combination of these three characteristics, which can complicate working in and around these spaces as well as rescue operations during emergencies.

Exemptions to the Rules for Confined Space Entry

A confined space may only be considered a permit-required confined space because of an actual or potential hazardous atmosphere. If continuous ventilation of such a space is sufficient to control the hazard, then the employer is not subject to all of the requirements in the standard. Instead, the employer can choose to follow these alternative requirements for entry.

- Eliminate any condition that makes it unsafe to remove an entrance cover before the cover is removed.
- Guard entrances with a barrier to prevent accidental falls into the space.
- Test the atmosphere for oxygen content, flammable gases and vapors, and potential toxic contaminants.
- Prohibit employee entrance into space with a hazardous atmosphere before and throughout an entry.
- Test the space periodically to ensure that a hazardous atmosphere has not developed.
- If a hazardous atmosphere develops, employees must leave the space.
- Measures must be taken to protect employees before re-entry.
- There must be written certification that the space is safe for entry.

from: *Basic Health and Safety Course for Hazardous Waste Site Personnel*, New England Consortium.


The Hazards in Confined Spaces

Oxygen-Deficient Atmospheres

An oxygen-deficient atmosphere has less than 19.5% available oxygen (O₂). You should **not** enter any atmosphere having less than 19.5% oxygen without wearing an approved self-contained breathing apparatus (SCBA).

The oxygen level in a confined space can decrease because of work being done, such as welding, cutting, or brazing; or it can be decreased by certain chemical reactions (for example, rusting) or through fermentation. The oxygen level also decreases if another gas, such as carbon dioxide or nitrogen, displaces it. Total displacement of oxygen by another gas will result in unconsciousness, followed by death.

The Health Effects of Different Levels of Oxygen	
Level of Oxygen	Result
21%	Plenty of oxygen
19.5%	Enough oxygen to enter a confined space
16%	Tire rapidly; cannot think clearly
14%	Not enough oxygen; difficult to breathe
6%	Cannot breathe; death



Flammable Atmospheres

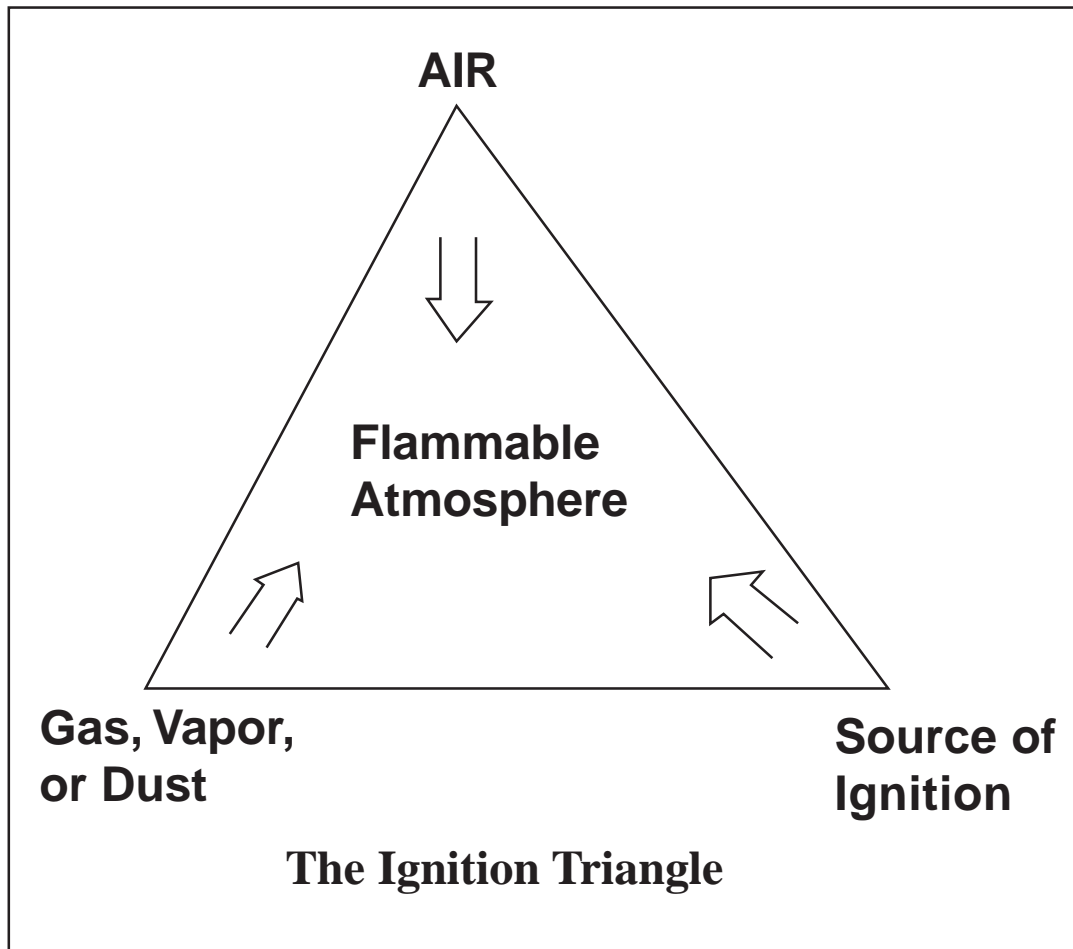
Two things make an atmosphere flammable:

- the amount of oxygen in the air; and
- a specific mixture of flammable gas, vapor, or dust.

If a source of ignition (for example, a sparking or electrical tool) is used in a space containing a flammable atmosphere, an explosion will result.

If the air in a confined space is rich in oxygen (above 21 %), flammable materials, such as clothing and hair, will burn quickly when ignited. Therefore, **never use pure oxygen to ventilate a confined space.** Ventilate with normal air.

If the LEL of the CHEM is 10% or greater, workers shall evaluate the tank until these conditions can be lowered.



Toxic Atmospheres

Most liquids, vapors, gases, mists, solids, and dusts that you work with should be considered hazardous in a confined space. Toxic materials can come from:

- Products stored in a confined space

Products stored in a confined space can be absorbed into the walls and give off toxic gases. When cleaning the walls, toxic gases can give off gas. For example, in the removal of sludge from a tank, decomposed material can give off deadly hydrogen gas.

- **Work in and around confined spaces**

Toxic atmospheres are created in many processes. Examples include welding, cutting, brazing, painting, scraping, sanding and degreasing. Many of the industrial cleaning solvents are very toxic in a confined space.

Toxic materials produced by work near a confined space can also enter and build up in a confined space.

General Physical Hazards

In addition to hazardous atmospheres, confined spaces may also contain potential hazards such as electrical shock, radiation machinery and other hazards as:

Extreme Temperatures:

Extremely hot or cold temperatures can be a problem for workers in a confined space. For example, if the space has been steam cleaned, it should be allowed to cool before any entry is made.

Noise:

Noise within a confined space can be amplified because of the design and acoustic properties of the space. This can damage hearing and interfere with communication, causing a shouted warning to go unheard.

Slick/wet Surfaces:

Slips and falls can occur on a wet surface causing injury or death to workers. Also, a wet surface will increase the chance of injury from electric shock in areas where electrical circuits, equipment, and tools are used.

Falling Objects:

Workers in confined spaces should be careful of the possibility of falling objects, especially in spaces, which have topside openings for entry, and where work is being done above the worker.

Engulfment Hazards:

Loose, granular material (such as grain, sand, coal, or similar material), stored in bins and hoppers, or liquid (such as chemicals water, or beer) can engulf and suffocate a worker. By crusting or bridging over in a bin appearing to be a firm surface, break loose under the weight of a worker (see figure below).

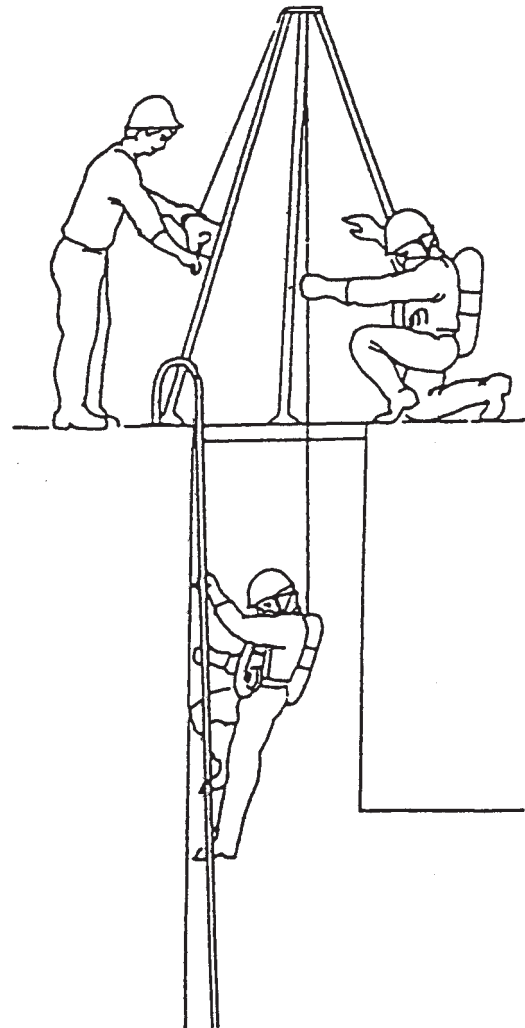
Standby and Rescue

A standby person should be assigned to remain on the outside of the confined space and be in constant contact (visual or speech) with the workers inside. The standby person should not have any other duties but to serve as standby and know who should be notified in case of emergency. Standby personnel should not enter a confined space until help arrives, and then only with proper protective equipment, life lines, and respirators.

Over 50% of the workers who die in confined spaces are attempting to rescue other workers. Rescuers must be trained in and follow established emergency procedures and use appropriate equipment and techniques (lifelines, respiratory protection, standby persons, etc.). Steps for safe rescue should be included in all confined space entry procedures.

Rescue should be well planned and drills should be frequently conducted on emergency procedures.

Unplanned rescue, such as when someone instinctively rushes in to help a downed co-worker, can easily result in a double fatality, or even multiple fatalities if there are more than one would-be rescuers.



Entry with Holst and Standby Personnel

REMEMBER, AN UNPLANNED RESCUE WILL PROBABLY BE YOUR LAST!

CONFINED SPACE EXPLOSION

An employee in Arizona entered a solvent storage tank to remove toluene residues. The tank was 20 feet tall and 10 feet in diameter. The employer had rented a self-contained breathing apparatus for this entry and showed the employee how to use it. However, the tank atmosphere had not been tested, nor had any provisions for rescue been made. The employee could not fit through the tank's opening while wearing the SCBA. The employer decided that the SCBA would be loosely strapped to the worker so it could be lowered over his head.

However, the worker, who did not speak English well, misunderstood and entered without the SCBA. When the supervisor realized what happened he tried unsuccessfully to get the worker to climb out. He lowered the SCBA, but the worker was already unconscious. A call for help was sent to the city fire department. Because of the small opening, firefighters who responded to the rescue call could not enter the tank while wearing SCBA's. They decided that only by cutting open the side of the tank could they possibly rescue the victim. To reduce the possibility of sparking, water was sprayed into the tank. This failed. The toluene vapor in the tank ignited. The tank exploded, killing one firefighter and injuring 16 others.

It was later determined that the entrant was already dead before the explosion occurred due to toxic effects of toluene and lack of oxygen.

* Source: *Worker Deaths in Confined Spaces*, NIOSH, 1994

Methods for a Safe Confined Space Entry

Employers should make available to employees a list of all confined spaces. Workers should be trained to identify confined spaces and the hazards that may be found in them. This training should stress that death is the likely outcome if the following precautions are not taken **before entry** is made:

Written Entry Permit (Safe Work Permit)

A set of established written work procedures that explains how jobs in each confined space shall be done, posted at the jobsite entry.

Air Monitoring

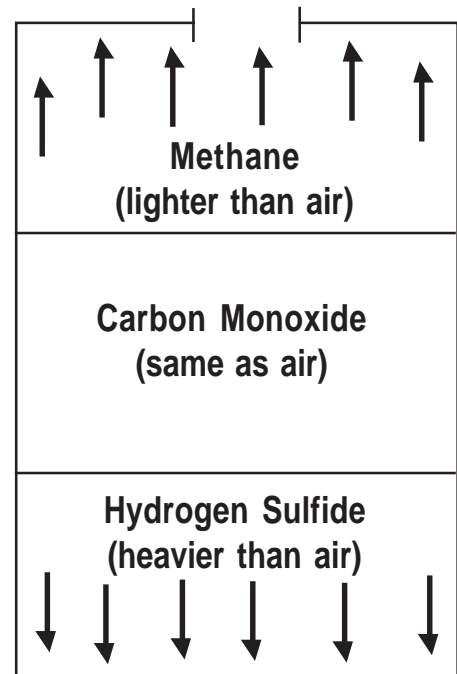
Remember that some gases or vapors are “heavier” than air and will settle to the bottom of a confined space.

Also, some gases are “lighter” than air and will be found around the top of the confined space.

Therefore, it is very important that a qualified person monitor all areas (top, middle, bottom) of a confined space for toxic gases and vapors before anyone enters it. Monitoring for oxygen level, flammability, and known or suspected toxic materials should all be conducted.

If testing reveals oxygen deficiency, toxic gases and vapors, or flammable gases and vapors, the space must be ventilated and re-tested before workers enter. If ventilation is not possible and entry is necessary (for emergency rescue, for example), workers must have appropriate respiratory protections.

Never trust your senses to determine if the air in a confined space is safe! You can **not** see or smell many toxic or flammable gases and vapors, nor can you determine the level of oxygen present. A confined space should be monitored continuously to determine whether the atmosphere has changed due to the work being done.

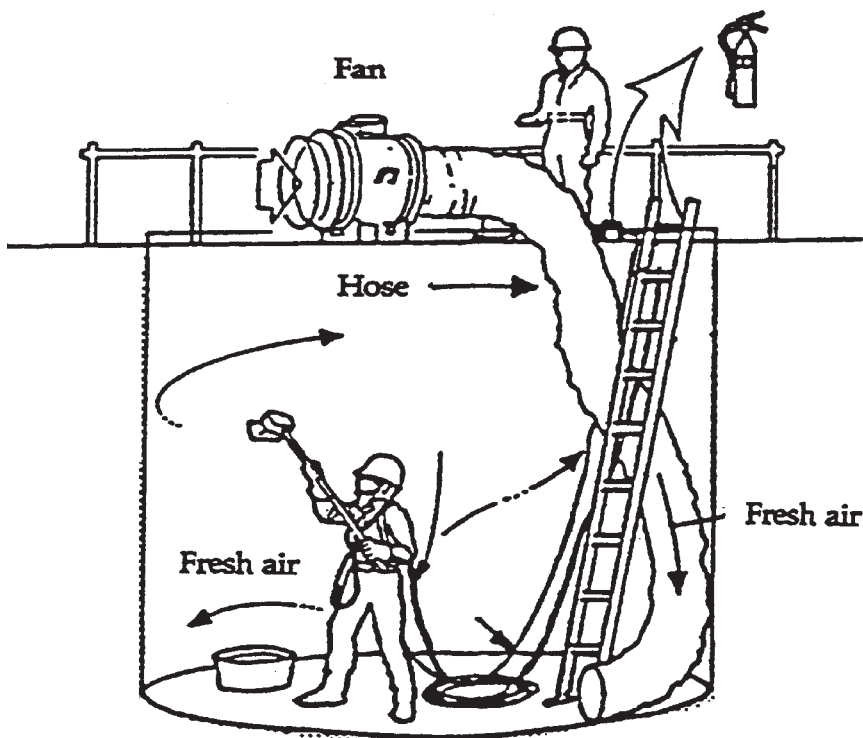


Ventilation

Ventilation by a blower or fan may be necessary to remove harmful gases and vapors from a confined space. The method and equipment to use depend on:

- the size of the confined space openings,
- the gases to be ventilated out (for example, are they flammable?),
- the source of the fresh air (the air that is blown into the confined space).

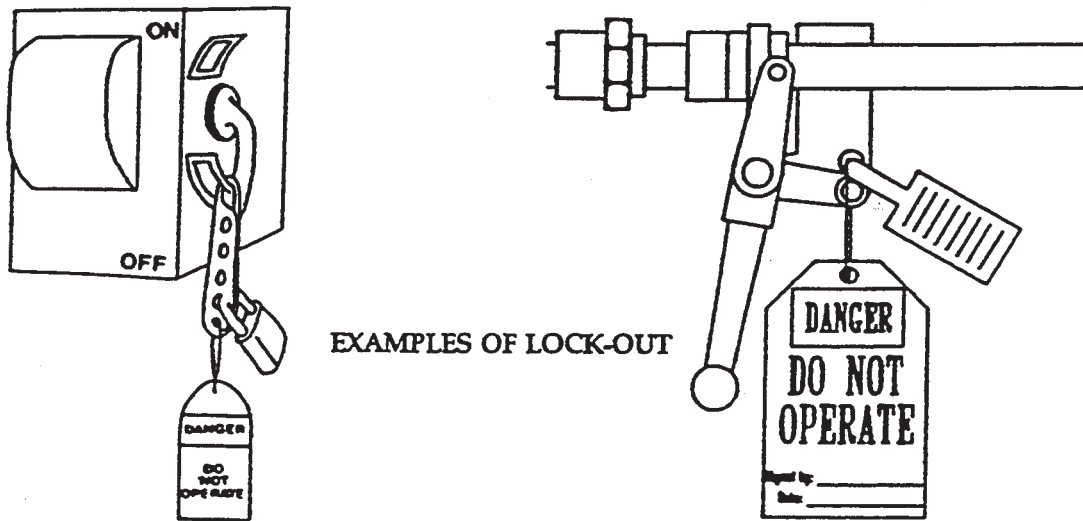
A common method of ventilation requires a large hose with one end attached to a fan and the other lowered into a manhole or opening. For example, in a manhole the ventilating hose would run to the bottom to blow out all harmful gases and vapors (see figure below). The fan should be placed in an area that will draw in fresh air only. Ventilation should be continuous where possible, because in many confined spaces the hazardous atmosphere will form again when the flow of air is stopped.



Isolation

Isolation is the process of putting an area out of service. Whenever the safety of a confined space entry cannot be ensured, the space should be isolated. There are several methods to remove a confined space from service:

- **Lock-out** of electrical sources, preferably with the use of disconnect switches far from the equipment;
- **Blanking and bleeding** of pneumatic and hydraulic lines;
- **Disconnecting** belt and chain drives and mechanical linkages on shaft-driven equipment where possible, and;
- **Securing** mechanical moving parts within confined spaces with latches, chains, chocks, blocks, or other devices.

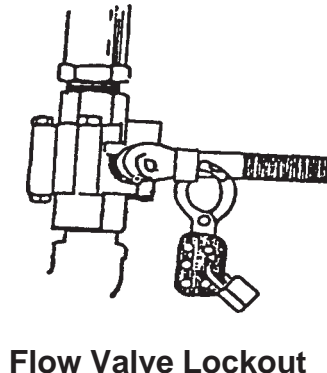
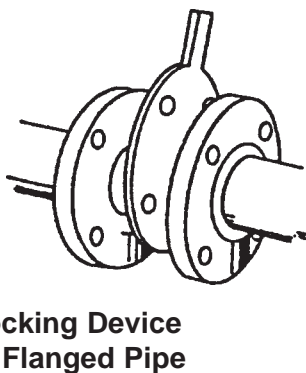
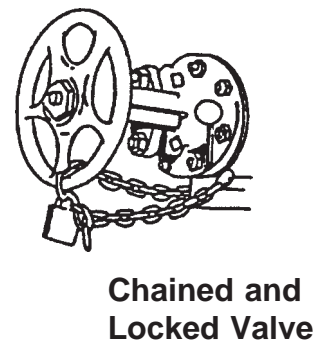
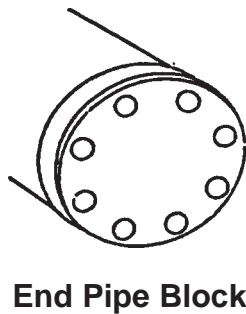
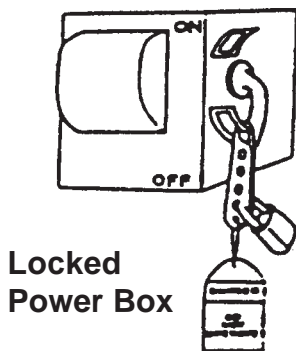


How To Establish An Effective Lockout Program

The only “fail-safe” plan is to achieve a zero energy state. This means neutralizing all energy sources before maintenance, set-up, or service work is attempted. A complete lockout procedure must include the following:

1. A clear commitment from higher management.
2. A comprehensive survey of energy sources.
3. A written plan that addresses all energy sources and strives for zero energy states.
4. Training of all personnel, not only those actually using lock out, since anyone could come by and activate the machinery while it is being worked on.
5. Provision of a sturdy lock and a unique key to all personnel who will need them.
6. Regular review and adjustment of the program.

Methods of Lockout



from: *Basic Health and Safety Course for Hazardous Waste Site Personnel*, New England Consortium.

A Sample Lockout Procedure

A good lockout procedure, at a minimum, should contain the following parts:

1. All maintenance personnel will be provided with a good lock. The lock will have the individual worker's name and other identification on it. Each worker will have the only key to the lock.
2. BEFORE turning off the power, the worker should check to be sure that no one is operating the machinery. The machine operator will be informed before the power is turned off. Sudden loss of power could cause an accident.
3. Steam, air, and hydraulic lines will be bled, drained, and cleaned out. There should be no pressure in the lines or in reservoir tanks. In some cases, such as pipelines, complete draining is not possible and the pipes are "blanked" instead. This involves inserting a circular disk into the line to block flow, and then draining the blocked off portion.
4. Any mechanism under tension or pressure, such as springs, will be released and blocked.
5. Each person working on the machinery will put a lock on the machine's lockout device(s). Each lock will remain on the machine until the work is completed.
6. All energy sources which could activate the machine will be locked out.
7. The main valve or main electrical disconnect will be tested to be sure that the power to the machine is off.
8. Electrical circuits will be checked with proper and calibrated electrical testing equipment. An electrical failure could energize the equipment even if the switch is in the off position. Stored energy in electrical capacitors should be safely discharged.
9. When working on machinery such as power presses and welding presses that have a ram which could fall, the ram will be supported with safety blocks or pins. Fully interlocked safety blocks are the safest.

from: *Basic Health and Safety Course for Hazardous Waste Site Personnel*, New England Consortium.

What About Tags?

Tags are sometimes used in place of locks to prevent accidental start up of machinery. This is a risky approach and should not be relied upon except for very brief periods, or when a locking mechanism is absolutely impossible. OSHA says a “Do Not Start” tag on power equipment shall be used for a few moments or a very short time until the switch in the system can be locked out.

For the rare instances where tags are used, they must be highly visible and placed in a conspicuous location that effectively stops people from operating the starting mechanism. All personnel must be trained in the meanings of any tags used and the serious hazards resulting from not heeding the warnings.

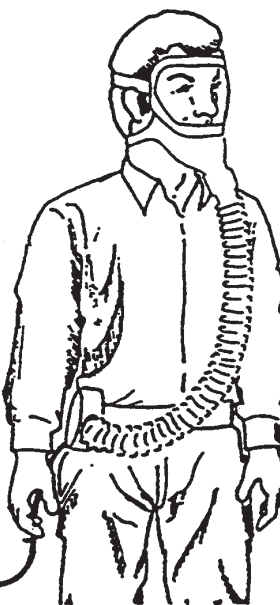
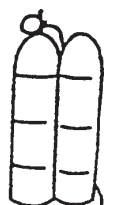
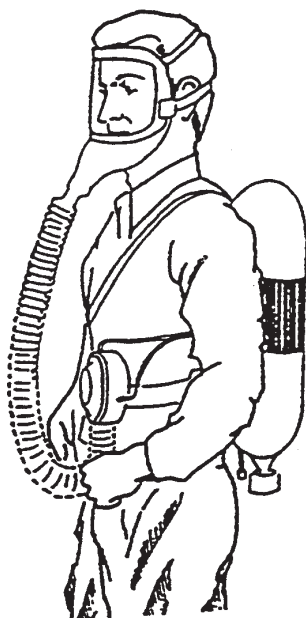


Respiratory Protection

Respirators allow you to breathe safely without inhaling toxic gases or particles. (For a review of air-purifying and air-supplying respirators see modules 7c-7e). Use only air-supplying respirators in confined spaces where there is not enough oxygen.

AIR-SUPPLIED RESPIRATORS

Self-Contained
Breathing
Apparatus
SCBA



Supplied Air
Respirator with
Auxiliary Escape
SCBA

AIR PURIFYING RESPIRATORS

(Do **not** use these in oxygen-deficient atmospheres)



Half-mask



Full-face

COMMUNICATION

Due to work conditions, workers may not be able to communicate. Alternative communications should be available for emergencies such as horns, ropes, or intrinsically safe electronic communication.

Rescue Plan

Over 60% of workers who die in confined spaces are trying to rescue other workers.

Therefore, an appropriate standby and rescue plan is especially important for anyone working in a confined space.

Rescuers must be trained in and follow established emergency procedures. They must also use proper equipment such as respiratory protection.

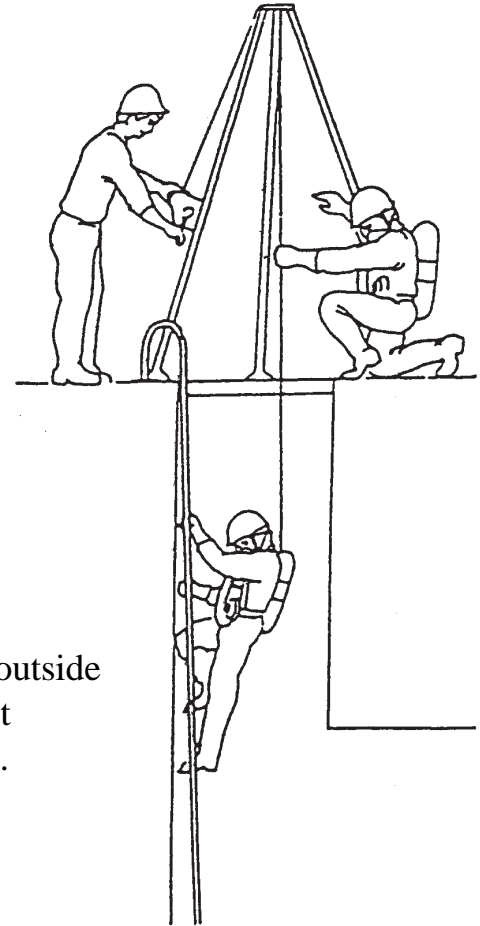
Steps for a safe rescue should be:

- included in all confined space entry procedures.
- established **before entry**.
- specific for each type of confined space.
- well planned and practiced often enough to ensure an efficient and calm response to any emergency. Unplanned rescue such as when someone rushes in without thinking, can easily result in another death.

A standby person is someone assigned to remain on the outside of the confined space. The standby should be in constant contact (through sight or speech) with the workers inside.

The standby person should:

- not have any other duties but to serve as standby.
- be equipped with rescue equipment including a safety line attached to the worker in the confined space, SCBA, protective clothing, boots, etc.
- know who to notify in case of emergency.
- the standby person may enter a confined space in case of emergency but must alert at least one additional employee outside of the confined space of the emergency and of his/her intent to enter the confined space.



Remember: An unplanned rescue will probably be your last!

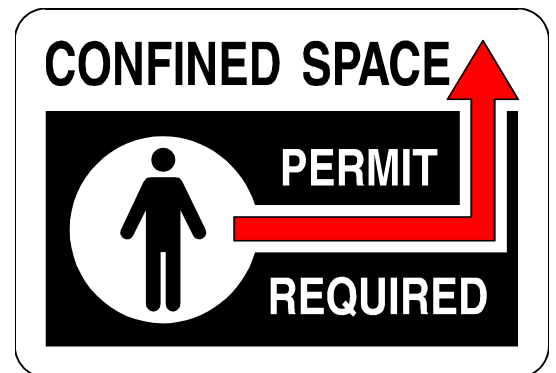
Entry Permit System

Entry permits provide documentation that the appropriate procedures for safe entry have been followed. Whenever a worker is required to enter a confined space, an entry supervisor must sign an entry permit to authorize entry. The permit must be made available to all entry personnel. It is valid only for the amount of time it takes to complete the task specified on the permit, but for no longer than one shift. It must be cancelled on completion of the job. Permits must be kept on record for at least one year.

What Is on an Entry Permit?

Entry permits must include the following information.

- The identification of the space to be entered
- Hazard control measures
- The purpose of entry
- Conditions acceptable for entry
- The date and duration of the permit
- Results of initial and periodic monitoring
- The names of authorized entrants
- Rescue and emergency numbers
- The names of attendants
- Communication between entrants and attendants
- The name of the entry supervisor
- Equipment to be used for safe entry
- The hazards of the space
- Any other information specific to the space being entered



Examples of confined spaces permits are in Appendix A at the back of the Cal/OSHA standard.

from: *Basic Health and Safety Course for Hazardous Waste Site Personnel*, New England Consortium.

The Cal/OSHA Confined Spaces Standard

Both private and public sector workers in California are covered by a set of Confined Spaces standards: GISO 5156, 5157 and 5158.

Cal-OSHA requires employers to:

- evaluate the workplace to identify any confined spaces requiring a permit
- conduct air monitoring
- provide respirators and safety equipment (harnesses, belts)
- follow specified operating procedures
- provide employee training
- develop written procedures for confined spaces entry—with clearly designated duties for entrants, attendants and supervisors
- designate outside attendants & rescuers, with PPE
- develop and follow emergency and rescue procedures
- develop and use a written permit system

Make sure your employer is following the revised 1994
Cal-OSHA standards and the 1999 federal OSHA
requirements to provide greater worker participation.

A copy of the Cal-OSHA Confined Spaces standards is in Appendix A; it contains sample entry permit forms. The three related standards were created in 1994 to replace and update an earlier standard, GISO 5156. In addition, federal OSHA revised its confined spaces standard in 1999 to require employers to share information and involve workers more in the development of the written confined space permit program. See next page for more details.

Changes in the Federal OSHA Permit-Required Confined Spaces Standard (29 CFR 1910.146)

Topic	Old Standard	New Standard
Clarification of the need to provide authorized representatives with information required by the standard	The written program, which contains the employer's procedures and policies for implementing that program, is to be available for inspection and copying by employees and their authorized representatives	Additional clarification of the Agency's intent for authorized representative(s) of the employees to have access to any information provided to employees under the standard
Observation of pre-entry atmospheric testing	No provisions	Employers whose employees enter permit spaces are required to allow employees or their authorized representative(s) an opportunity to observe both the testing of the space during pre-entry and the periodic testing
Evaluation of selection of rescue and emergency services	Specific requirements are required for in-house teams employed by the employer without containing equally explicit requirements for outside rescue teams	Clarification of an employer's obligations to select a rescue service that is trained, equipped, and available to respond during confined space entries. It includes factors that an employer must consider in selecting a rescue team and a non-mandatory Appendix F to provide employers with additional assistance in evaluation
Employee Participation	None	A new paragraph is added to ensure employee involvement in permit space program development and implementation



Noise: Health Effects and Controls



Outline

1. How Much is “Too Much” Noise?
2. Health Effects of Noise
3. Anatomy of the Ear
4. Measuring Noise Levels: Decibels
5. Monitoring Noise Levels
6. Controlling Noise Levels
7. Cal/OSHA’s Noise Control Standard — Summary
8. Appendix A: Effects of Excessive Noise
9. Appendix B: Noise Monitoring with Sound Level Meter
10. Appendix C: Ear Plugs Don’t Work
11. Appendix D: How to Understand Your Audiogram

Objectives

Participants will be able to:

1. Recognize the health effects of being exposed to high levels of noise.
2. Describe how a sound level meter works.
3. Discuss the basic Cal/OSHA limits for noise.
4. Describe basic components of a hearing conservation program.

Noise Health Effects and Controls

What is Noise? Is conversation with friends and family noise? Is music noise?
Is a factory machine running at high-speed noise?

The only difference between music and factory sounds is whether the sound is desired. In most cases the music is wanted sound and the factory noise is unwanted sound. Noise is defined as “unwanted sound.”

There are many sources of noise in the workplace. These include machinery which has moving parts and metal-on-metal contacts; vehicles; pumps and compressors; air hoses; and many others.

However, even the most desired music can be just as damaging to the human ear as the worst factory noise. The health effects depend on the loudness of the sound, not whether the sound is wanted or not.

How Much is “Too Much” Noise?

Simple ways of determining if noise levels at work are too high include:

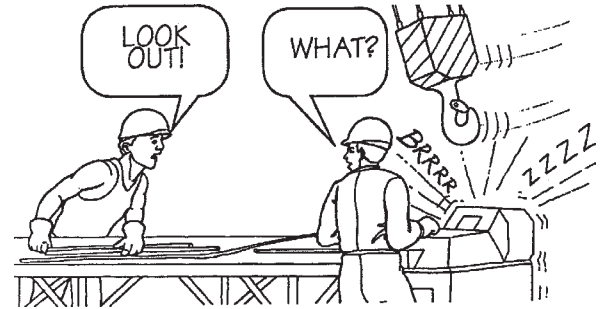
- if you have to yell or speak loudly to be understood at an arm’s length away from someone else
- if your ears are ringing when you leave the area
- if you have difficulty hearing a normal conversation after work
- if you get headaches or feel dizzy from the noise
- if any of your co-workers also have these problems or have been diagnosed by a doctor with hearing problems



Health Effects of Noise

High levels of noise can have both immediate and long-term effects on hearing. High noise levels can cause:

- hearing loss, both temporary and permanent
- headaches
- dizziness
- high blood pressure
- nervousness and stress leading to stomach ulcers, sleeping problems, heart disease
- loss of concentration
- accidents if warning alarms or shouts are not heard.



The level of damage to the ear can be determined by hearing tests called “audiograms.” Loss of hearing in the range of sound where human speech occurs (between 2,000 and 4,000 Hertz) has temporary and permanent effects.

Some Other Hazards of Noise

A Noisy Work Environment Contributes to Accidents

Cal/OSHA Noise Standard is set to protect workers from permanent hearing loss. However, noise levels below OSHA permissible limits can impact people’s ability to carry out an assigned task, by causing anxiety or fatigue.

Noise can increase human error, contributing to accidents by:

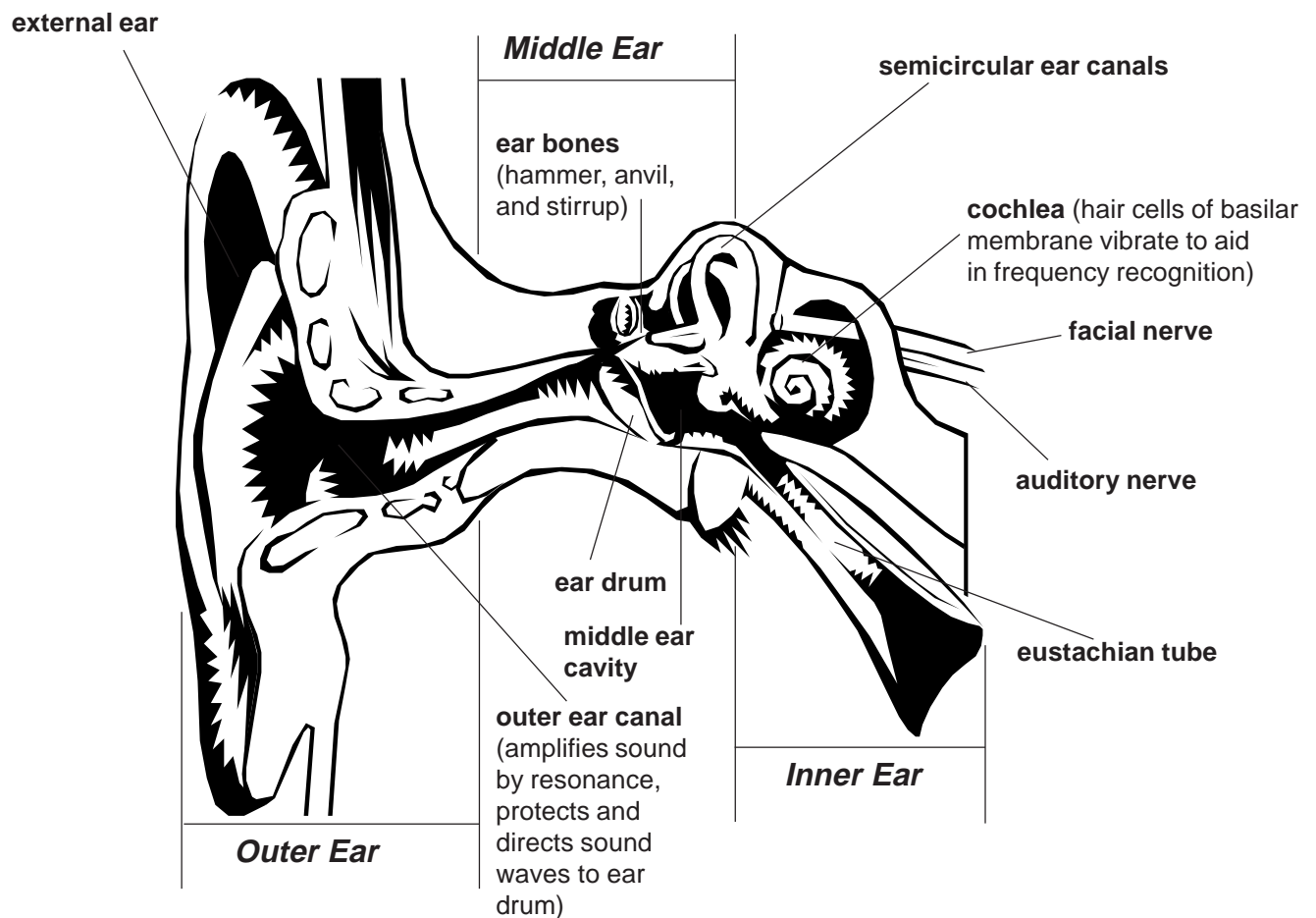
- “masking” audible alarms, verbal messages, etc.
- increasing worker fatigue and anxiety
- harder to process complex info for difficult tasks
- harder to monitor and interpret unusual events, by narrowing the span of attention.

Noise May Contribute to Heart Disease

Exposure to loud noise can cause the blood vessel to constrict. This makes the heart work harder to pump the same amount of blood around. Through the years, this may contribute to heart disease.

Anatomy of the Ear

The anatomy of the ear consists of the outer ear, the middle ear and the inner ear.



Ear Canal Cross Section

There is a spiral-shaped bone in the inner ear called the cochlea, which is lined with tiny hair cells. Sound waves are transmitted via the outer ear, through the middle ear, to the inner ear. In the inner ear, the sound wave pressure moves the hair cells, which then send messages to the brain, via the nervous system, about the sounds heard by the ear.

High noise levels will damage the hair cells in the inner ear and reduce the ability of the ear to “hear” sounds and transmit the information to the brain. Once the hair cells in the inner ear have been damaged, there is no way to repair the damage.

HEARING LOSS IS PERMANENT!

Measuring Noise Levels: What Are Decibels?

Decibels

Noise is measured in units called “decibels” which is a measure of how much pressure is created by the sound wave producing the sound. The range of decibels is from 0 to about 140, or from the smallest sound human ears can hear to the sound level that will do immediate and permanent damage to the ear. The word “decibels” is abbreviated as “dB” and there are three scales – A, B and C – but the scale closest to human hearing is the A scale or “dBA.”

0 dB — Minimum level needed to hear a sound

10 dB—A whisper; leaves blowing in the wind

40 dB—A quiet office

70 dB—A traffic jam

90 dB—Heavy machinery

130 dB—A jet engine at 10 meters

Monitoring Workplace Noise Levels

Two kinds of measurements can be taken to determine noise levels in the workplace.

Direct Reading Instruments

A “direct-reading” instrument called a “sound level meter” is used to measure sound at one particular moment. Usually sound level meter readings are taken to identify areas where noise levels appear to be higher than the occupational exposure limit, 85 dBA.

Personal Dosimeter

A “personal dosimeter” is used to determine the amount of sound the worker hears over the entire work shift. This should cover the entire work shift—8, 10 or 12 hours, or however long the shift is. The dosimeter is placed on the worker’s belt and a small

microphone is located near the worker's ear. The dosimeter measures the amount of sound the worker hears over the entire work shift.

Both sound level meters and personal dosimeters give a numerical result that can be compared to the occupational exposure limit of 85 dBA for an 8-hour shift, 40-hour work week (lower for longer shifts).

Decibels are measured on a special scale—a logarithmic scale where every increase in 3 decibels actually doubles the intensity of the sound. That means that an increase from 90 decibels to 93 decibels means the sound is twice as loud. An increase from 90 dBA to 96 dBA would mean the sound level is four times as loud.

90 dB—Heavy machinery

93 dB—Twice as loud

96 dB—4 times as loud

99 dB—8 times as loud

The important thing to remember is that a small increase in decibels means a large increase in the sound level and the damage it can do to the ear.

Controlling Noise Levels

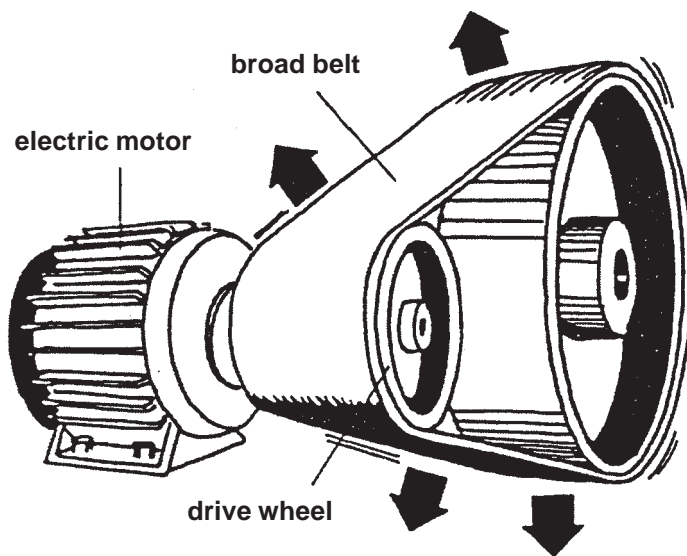
If noise levels are found to be above 85 dBA for an 8-hour shift, 40-hour work week, the employer is required by law to reduce the noise levels.

Engineering controls at the source of the noise are the most effective means of reducing noise levels. The controls should always reduce the loudest source of the noise first. Engineering controls include:

- redesigning equipment to reduce the speed or impact of moving parts; to install mufflers on intakes and exhausts; to replace old equipment with newer, better designed equipment;
- servicing and maintaining equipment to replace worn parts and to lubricate all moving parts;

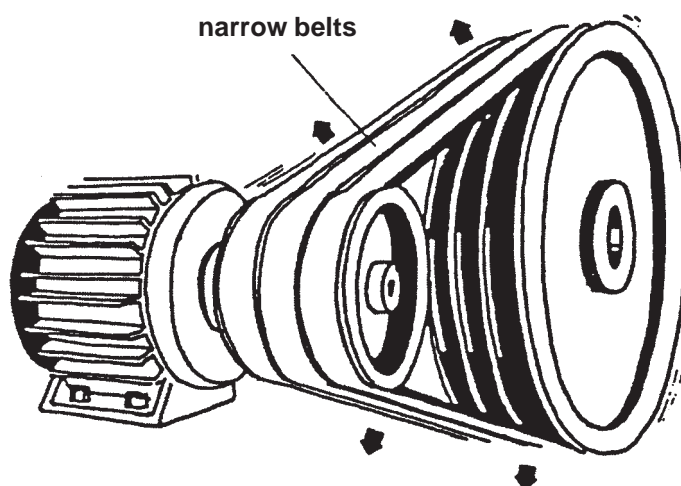
- isolating equipment either by distance, by enclosures or by barriers;
- damping and cushioning noise sources by using rubber pads to reduce vibration and noise coming from metal parts; reducing the drop height of objects falling into bins or onto belts;
- installing absorptive baffles in work areas to absorb sounds generated there.

Examples of Engineering Controls



Problem

A belt drive provides a large amount of low frequency noise because of the vibration of the broad belt.

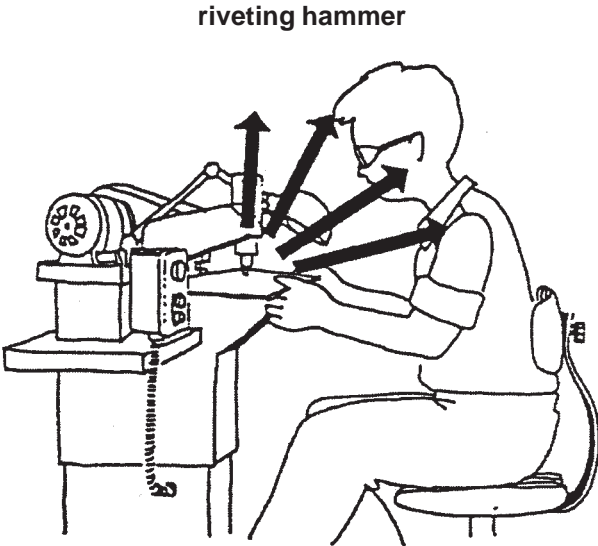


Control measure

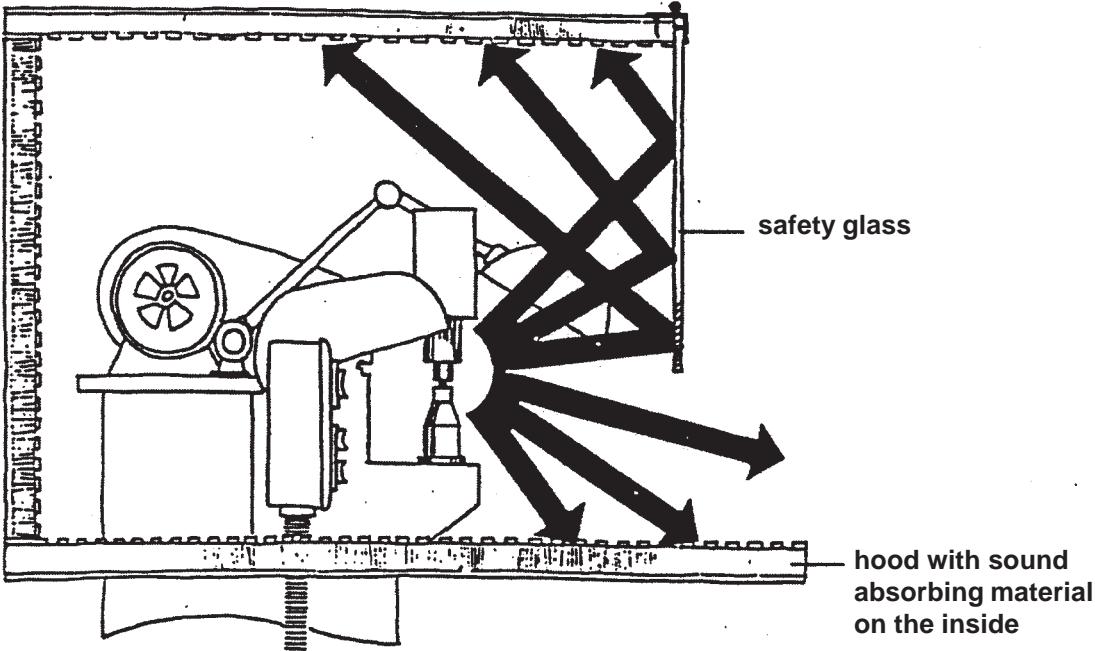
The broad drive belt is replaced by narrower belts, separated by spacers. This reduces the noise problem.

Examples of Engineering Controls

Problem

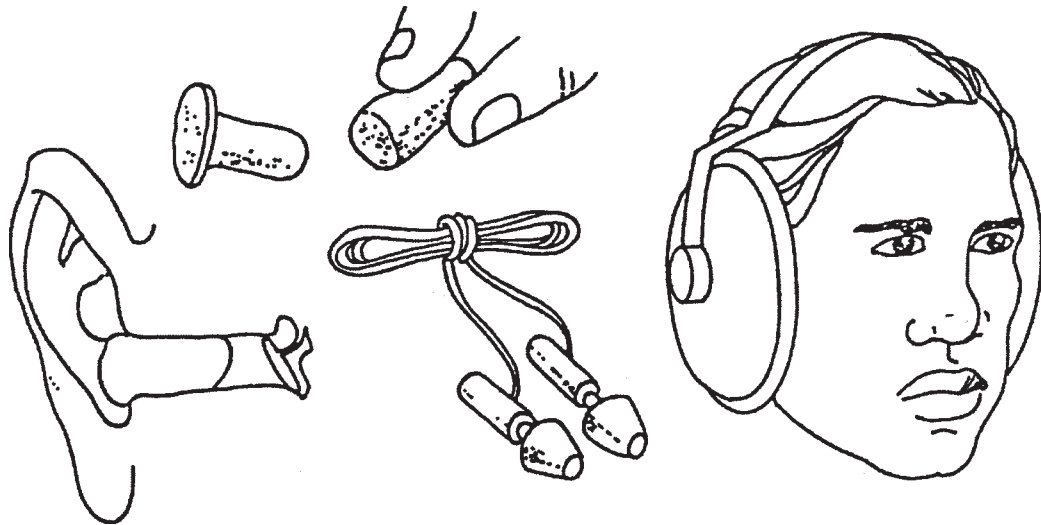


Control measure



Administrative controls for noise reduction include rotating workers in and out of areas with high noise levels, and providing training to workers about noise hazards and ways to reduce noise exposures and protect hearing.

Personal protective equipment (PPE) for noise reduction includes ear plugs and ear muffs. Like all PPE, this control depends on selecting the correct equipment for the specific noise levels, and proper use and care of the equipment. It is important to recognize that the noise is still present, and that the PPE (if used correctly) simply reduces the amount of noise reaching the inner ear.



Some users of hearing protection equipment have developed serious ear infections that have damaged their hearing, so workers should be sure to report any health problems resulting from the use of PPE.

Control of Noise Exposure

Title 8, Calif. Code of Regs., Sections 5095 – 5100 (Cal/OSHA Standard)

Administrative or Engineering Controls: When employees are subjected to sound levels exceeding the sound levels in the table below, feasible administrative or engineering controls shall be utilized:

90 dBA...	8 hours per workday
95 dBA...	4 hours per workday
100 dBA...	2 hours per workday

105 dBA...	1 hour per workday
110 dBA...	30 minutes per workday
115 dBA	15 minutes per workday

Personal Protective Equipment: If feasible administrative or engineering controls fail to reduce sound levels within the levels from the above table, personal protective equipment shall be provided and used to reduce sound levels to within the levels of the table.

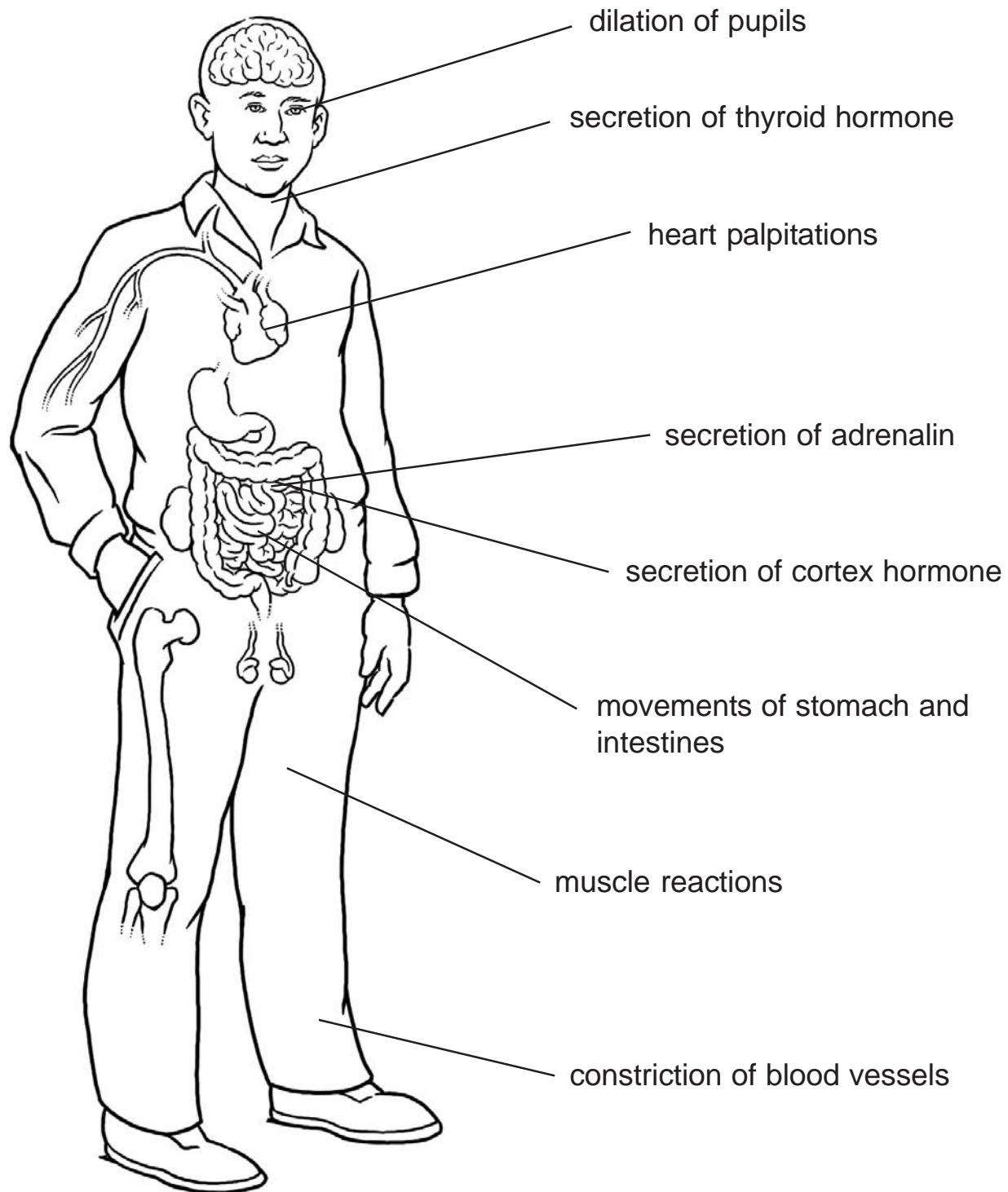
Impulsive or Impact Noise: Exposure to impulsive or impact noise should not exceed 140 dB peak sound pressure level.

Hearing Conservation Program: The employer shall administer a continuing, effective conservation program whenever employee noise exposures equal or exceed an 8-hour time-weighted average sound level (TWA) of 85 dBA (slow response), or equivalently, a dose of 50 percent. An effective hearing conservation program includes:

- Monitoring: initial monitoring and repeated monitoring whenever a change in production, process, equipment or controls increases noise exposures, as specified in the Cal/OSHA standard.
- Audiometric Testing Program, as specified in the Cal/OSHA standard.

Appendix A

Effects of Excessive Noise



Appendix B

Noise Monitoring with Sound Level Meter

Demonstration Checklist

1. Turn on the sound level meter. Make sure the batteries are sufficiently charged (absence of “LOBAT” indicator in the window).
2. Place the wind screen on the sound level meter.
3. Set the weighting switch to “A” (reflecting the frequency response of the human ear).
4. Set the decibel range to 30 – 100 dB.
5. Set the response switch to FAST (to measure short duration noises) or SLOW (to measure noise in most situations).
6. Set the mode switch to RUN (continuously displays the current sound level).
7. Turn on the calibrator. Make sure the battery is sufficiently charged (“LOBAT” indicator not lit).
8. Place the calibrator on the sound level meter. Make sure the meter reads at 114 dB.
9. Turn off the calibrator.
10. Turn on the radio.
11. Read the sound levels. Increase the decibel range of the meter if the overload indicator (red triangle) lights up. Decrease the decibel range if the underrange indicator (yellow triangle) lights up.
12. Turn off the sound level meter.

Appendix C

Ear Plugs Don't Work

NIOSH Criteria Document Proves the Need for Engineering Controls for Noise

Years ago, the battle for OSHA enforcement of the Noise Standard was lost in the Occupational Safety and Health Review Commission. The OSHR ruled that an employer could balance the cost of hearing conservation (earplugs and audiograms) against the cost of engineering controls of noise exposure. The rationale was that earplugs would protect, and any loss of hearing was the worker's own fault for not wearing them. NIOSH has shown that that isn't true.

The new NIOSH criteria document on noise compiles the scientific evidence which proves the need for engineering control of noise, and the ineffectiveness of Hearing Protection Devices. For years, so-called "hearing conservation" programs have provided workers with earplugs, and then measured how fast they were going deaf. We now know why these have failed. In addition, we now have new information confirming concerns that noise damages general health as well as hearing.

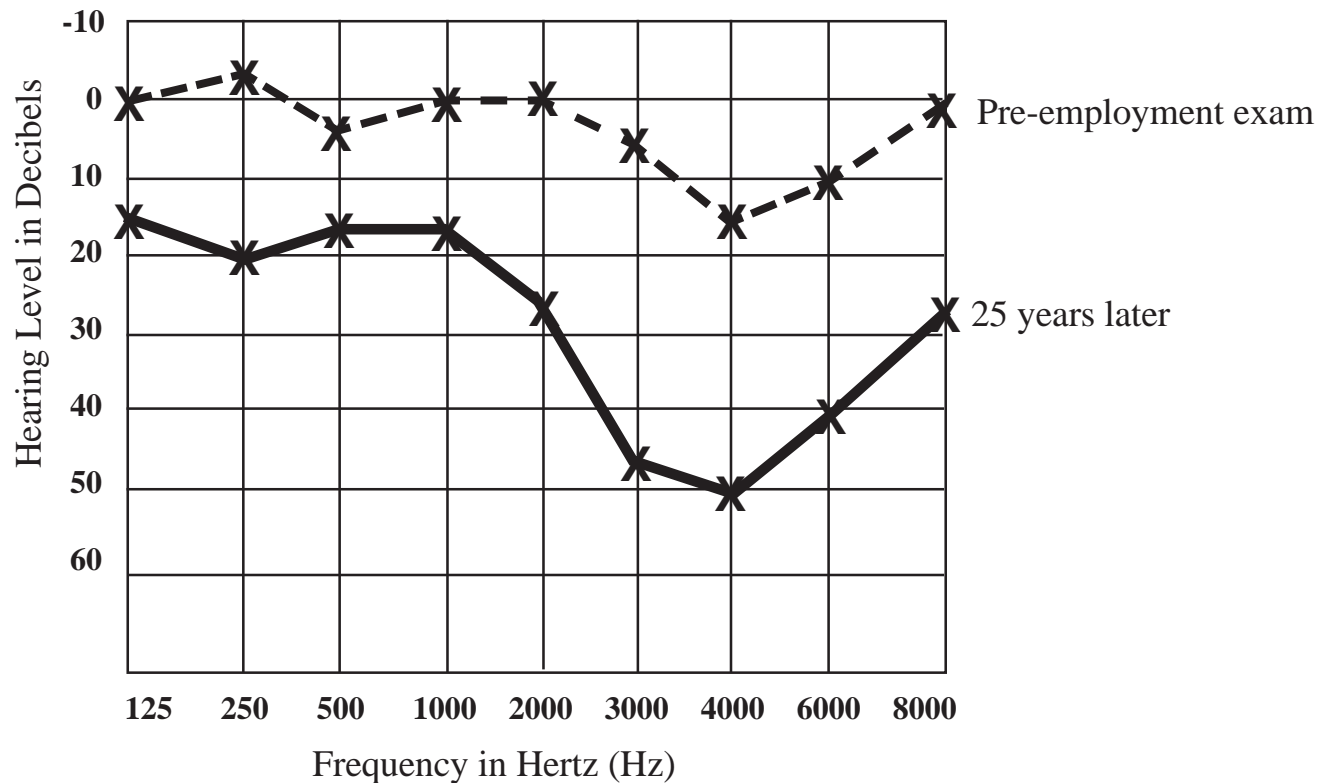
The key points documented by NIOSH are:

- Hearing loss begins at 80 dBA, not 85 or 90. Compiled studies show that 3% of employees exposed to 80 dBA average over a working lifetime will suffer moderate to severe hearing loss.
- Hearing protection devices provide only 10-15 dBA noise reduction. Manufacturers of HPDs advertise NRRs of 30 dBA or more based on laboratory tests, but field tests show much less protection. Earmuffs are better than soft plugs which are better than hard plugs, but all of them fail and leave workers at risk. An NRR of 10-15 dBA is the best you can expect.
- The worker's noise exposure inside the ear protector is equal to measured exposure with the NRR of hearing protection device subtracted. Any exposure over 95, and perhaps over 90, will result in moderate to severe hearing loss if it is permitted to continue.

In summary, workers who go deaf at work have been blamed for their own infirmity because they could have worn hearing protection devices. Of course, if you are exposed to noise above 80 dBA you should ask for and wear hearing protectors—you have to protect yourself. However, the hearing protectors won't be fully protective. So you also have to fight for engineering controls.

Appendix D

How To Understand Your Audiogram



An Audiogram Showing Hearing Loss

This audiogram is typical of someone whose hearing was damaged by noise. It is difficult without a work history to determine what sort of noise caused the loss, but the pattern shown in the graph is typical of that caused by noise. The numbers under the graph represent the various frequencies of sound heard during the hearing test. The numbers to the left indicate how many decibels loud the sound is in the ear when it is first perceived by the person taking the test. The dotted line on the upper part of the graph is taken from the pre-employment audiogram. The lower solid line is the results taken after 25 years exposure to a noisy machine. In this type of audiogram, the lower the line, the worse the hearing. Note that the hearing is worse and is lost first in the higher frequencies, especially at the 4000 Hz level. Different type graphs can be produced by different sorts of audiometers, but most usually look something like the one above. Each worker should always ask for a copy of the audiogram and a medical opinion (written if possible) on the results.

Evaluating the Exposure—The normal limits of hearing are about 10-15 decibels across the whole range of frequencies. Many people with good hearing actually have

audiogram results at zero and in the minus range. Any change at the 2000 Hz frequency is worrisome since this frequency is in the middle of the speech frequencies. Similarly any results worse than 20 decibels at 3000 and 4000 Hz is cause for concern. A person with an audiogram like the one above most likely has trouble hearing people speak clearly.

Compensation Schemes Most Workers' Compensation schemes take hearing loss at 500, 1000, and 2000 Hz and average them. Any result above 27 is compensable. In this case the hearing losses respectively are 15, 15, and 25, which average out to about 18 decibels loss. This is not enough to qualify for compensation, even though the worker is hard of hearing. The U.S. Department of Labor uses a slightly different formula for federal employees. The hearing losses are averaged instead at 1000, 2000, and 3000 Hertz. Thus, in this case, the losses are 15, 25, and 45 respectively, which averages out to 28 and might qualify for a small amount of compensation. Many reputable scientists believe that the loss at 4000 Hz should also be included in evaluations for compensation, but this usually is not done. The whole issue of compensation for hearing loss is actually more complicated than indicated here and is in need of considerable reform. Most states do not provide for any workers' compensation benefits for long term noise-induced hearing loss.



Handling Drums and Hazardous Waste Samples



Outline

1. Introduction
2. Types of Drums
3. Identifying Drum Contents
4. Drum Inspection, Handling, and Staging
5. Hazards Associated with Handling Drums
6. Preventing Accidents and Emergencies
7. Samples and Sampling Methods
8. Sampling Method Selection Criteria
9. Sampling Plan
10. Documentation (Field Logbook, Photographs, and Sample Labels)
11. Chain-of-Custody Procedures
12. Packaging and Shipping

Objectives

Participants will be able to:

1. Recognize different types of drums and their use.
2. Describe types of hazardous waste samples and methods of “containerizing.”
3. Describe hazards associated with handling drums and other containers and identify procedures to minimize these risks.
4. Identify safe work procedures and control methods for hazardous waste samples.

5. List types of equipment used to move drums.
6. Identify the regulations for the packaging, shipping, and handling of hazardous waste samples.

Introduction

Containers are handled during characterization and removal of their contents and during operations. Accidents may occur during handling of drums and other hazardous waste containers. Hazards include detonations, fires, explosions, vapor generation, and physical injury resulting from moving heavy containers by hand and working around stacked drums, heavy equipment, and deteriorated drums. While these hazards are always present, proper work practices — such as minimizing handling and using equipment and procedures, if feasible, that isolate workers from hazardous substances — can minimize the risks to site personnel.

Types of Drums

Closed-top drums are sealed and have small openings called bungs in the top through which liquids can be poured. Open-top drums have removable lids, and some do not have the small openings characteristic of the closed-top drum.

Type of Drum	Construction	Contents
Closed-top (bung)	Metal	Non corrosive products in liquid form
Closed-top (bung)	Plastic or composite (plastic inside metal or cardboard)	Liquid, acid, or bases
Open-top	Metal	Corrosive solids or sludge
Open-top	Polyethylene	Corrosive solids or sludge
Special	Stainless steel, nickel, and Aluminum	Extremely hazardous chemicals
Overpack	Metal or plastic	Any drums listed above
Closed-top drums with fittings (bungs)	Fittings for pressurizing with inert gas	Reactive, flammable, or explosive liquids
Open-top	Plastic or metal	Lab packs of a variety of potentially dangerous and incompatible material.

Determine drum type:

- a. **Polyethylene or PVC-Lined Drums:** These often contain strong acids or bases. If the lining is punctured, the contents may quickly corrode the metal, resulting in a significant leak or spill.
- b. **Metal Drum:** If a drum is made of a very expensive metal such as aluminum, nickel, or stainless steel, it may contain an extremely dangerous material.
- c. **Laboratory Packs:** These are used to dispose of used chemicals and wastes from laboratories and hospitals. They may contain incompatible materials, radioisotopes, shock sensitive, volatile, corrosive, or toxic chemicals. Special requirements for handling lab packs are also detailed by 2a CFR 1910.170 (j) (6).

Identifying Drum Contents

Drum contents may be difficult to identify (characterize). Unknown contents are dangerous because they may be toxic, reactive, ignitable, shock sensitive, corrosive, radioactive, or a combination of these. Before handling a drum, always be sure to take the following step:

- Look for symbols, words, or colors on the drum indicating that its contents are hazardous. Look for special markings such as NFPA 704 Hazard Diamond, DOT hazard identification, EPA Hazardous Waste Label, Department of Energy radiation label, or pesticide label.



Drum Inspection, Handling, and Staging

Inspection

The appropriate procedures for handling drums depend on the drum contents. Thus, prior to any handling, drums should be visually inspected to gain as much information as possible about their contents. The inspection crew should look for:

- Symbols, words, or other marks on the drum indicating that its contents are hazardous.
- Symbols, words, or other marks on a drum indicating that it contains discarded laboratory chemicals, reagents, or other potentially dangerous materials in small-volume individual containers.
- Signs of deterioration such as corrosion, rust, and leaks.
- Signs that the drum is under pressure such as swelling and bulging.
- Drum type.
- Configuration of the drumhead.

Conditions in the immediate vicinity of the drums may provide information about drum contents and their associated hazards. Monitoring should be conducted around the drums using instruments such as a gamma radiation survey instrument, organic vapor monitors, and a combustible gas meter.

As a precautionary measure, personnel should assume that unlabelled drums contain hazardous materials until their contents are characterized. Also, they should be aware of mislabeled drums that are reused.

Planning

Since drum handling is fraught with danger, every step of the operation should be carefully planned, based on all the information available at the time. The results of the preliminary inspection can be used to determine:

1. if any hazards are present and the appropriate response

2. which drums need to be moved in order to be opened and sampled.

A preliminary plan should be developed which specifies the extent of handling necessary, the personnel selected for the job, and the most appropriate procedures based on hazards associated with the probable drum contents as determined by visual inspection.

Handling

The purpose of handling is:

1. To respond to any obvious problems that might impair worker safety, such as radioactivity, leakage, or the presence of explosive substances.
2. To unstack and orient drums for sampling.
3. To organize, if necessary, drums into different areas on site to facilitate characterization and remedial action.

Prior to handling, all personnel should be warned about the hazards of handling, and be instructed to minimize handling as much as possible. In all phases of handling, personnel should be alert for new information about potential hazards.

The major causes of leaks and spills at hazardous waste sites are:

- Swollen containers due to pressure of contents.
- Damage from rough handling during transport.
- Drum bungs that are not completely tightened.
- Corrosion from contact with the soil or from acids or chlorinated hydrocarbons in the drums.

Overpack drums (larger drums in which leaking or damaged drums are placed for storage or shipment) and an adequate volume of absorbent should be kept near areas where minor spills may occur.

Where major spills may occur, a containment berm adequate to contain the entire volume of liquid in the drums should be constructed before handling takes place.

Keep absorbent spill control materials (brooms, bulk solid absorbent such as vermiculite) available on site.



There is some equipment which can be used to move drums:

- A drum grappler attached to a hydraulic excavator.
- A small front-end loader, which can be either loaded manually or equipped with a bucket sling.
- A rough terrain forklift.
- A roller conveyor equipped with solid rollers.
- Drum carts designed specifically for drum handling.



Drums are also sometimes moved manually. The drum grappler is the preferred piece of equipment for drum handling because it keeps the operator removed from the drums so that there is less likelihood of injury if the drums detonate or rupture.

If a drum is leaking, the operator can stop the leak by rotating the drum and immediately placing it into an overpack.

Drums that may contain explosive or shock-sensitive waste

- If a drum is suspected to contain explosive or shock-sensitive waste as determined by visual inspection, seek specialized assistance before any handling.
- Prior to handling these drums, make sure all non-essential personnel have moved a safe distance away.
- Use a grappler unit constructed for explosives containment for initial handling of such a drum.

- Palletize the drums prior to transport. Secure drums to pallets.
- Bulging drums are extremely hazardous. Wherever possible, do not move drums that may be under internal pressure, as evidenced by bulging or swelling.
- If a pressurized drum has to be moved, whenever possible handle the drum with a grappler unit constructed for explosive containment. Either move the bulged drum only as far as necessary to allow seating on firm ground, or carefully overpack the drum.

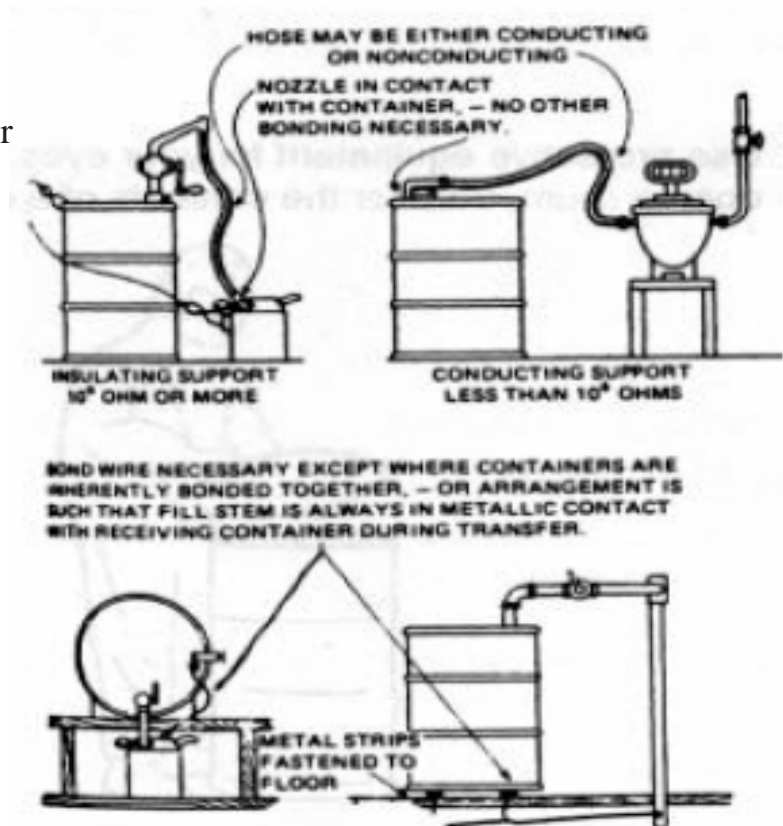


Leaking, Open, and Deteriorated Drums

If a drum containing a liquid cannot be moved without rupture, immediately transfer its contents to another drum using a pump designed for transferring that liquid.

When transferring combustible liquids from one drum to another, be sure that the two containers are bonded and grounded.

Two containers are **bonded** when a heavy copper wire is soldered between both containers. A container is **grounded** when a copper wire from the container to the ground prevents sparks or shocks by dissipating the static charge to the ground.



Use protective equipment for your eyes, skin, and lungs when you open a drum, transfer the contents of a drum, or clean a spill.

Drum opening

There are three basic techniques available for opening drums at hazardous waste sites:

- Manual opening with non-sparking bung wrenches.
- Drum de-heading.
- Remote drum puncturing or bung removal.

The choice of drum opening techniques and accessories depends on the number of drums to be opened, their waste contents, and their physical condition.

Remote drum opening equipment should always be considered in order to protect worker safety. Under OSHA 1910.120, manual drum opening with bung wrenches or de-headers should be performed **ONLY** with structurally sound drums and waste contents that are known to be non-shock sensitive, non-reactive, non-explosive, and non-flammable.

Bung wrench

A common method for opening drums manually is using a universal bung wrench.

These wrenches have fittings made to remove nearly all commonly encountered bungs. They are usually constructed of a non-sparking metal alloy (i.e. brass, bronze/manganese, aluminum) formulated to reduce the likelihood of sparks.



The use of a “NON-SPARKING Wrench” does not completely eliminate the possibility of a spark being produced.

Staging

Although every attempt should be made to minimize drum handling, drums must sometimes be staged to facilitate characterization, remedial action, and to protect drums from potentially hazardous site conditions.

The number of staging areas necessary depends on site specific circumstances such as the scope of the operation, the accessibility of drums in their original positions, and perceived hazards.

During staging, the drums should be physically separated into the following categories: those containing liquids, those containing solids, those containing lab packs, and those which are empty. This is done because the strategy for sampling and handling drums/containers in each of these categories will be different. This may be achieved by visual inspection of the drum and its labels, codes, etc. Solids and sludge are typically disposed of in open top drums. Closed head drums with a bung opening generally contain liquid.

Where there is good reason to suspect that drums contain radioactive, explosive, or shock-sensitive materials, these drums should be staged in a separate isolated area. Placement of explosives and shock-sensitive materials in bermed and fenced areas will minimize the hazard and the adverse effects of any premature detonation of explosives.

Hazards Associated with Handling Drums

Working with drums and other containers can present the following six hazards:

1. Unknown materials
2. Spills, leaks and ruptures
3. Physical exposure (through lungs, skin or mouth) to toxic chemicals
4. Fires and explosions
5. Unforeseen emergencies
6. Back injuries.

Preventing physical exposure to toxic chemicals

When you work with drums it is important to protect your lungs, skin, and eyes from harmful contacts with chemicals. OSHA requires your employer to have a respiratory protection program. This program should state exactly what type of protection is necessary for each job where you work. If you do not know the contents of a drum, **use at least level B protection.**

Always open bulging, corroded, dented, and otherwise damaged drums by remote handling tools. If the contents of a drum are known to be non-explosive and the drums are not damaged, use the following safety procedures for manual opening.

- complete, appropriate protective equipment (respirators, splash aprons, eye protection, gloves)
- drum should be positioned upright, bung up, or, if a side bung is used, drum on its side, bung up
- wrench bung plug open slowly and steadily; keep fire extinguishers available
- if there is evidence of reactive, incompatible chemicals, pressurized contents or sudden release of toxic gases/vapors in high concentration, **STOP**, evacuate and finish the job using remote handling tools.

Preventing Accidents and Emergencies

Your workplace should have an **emergency action plan** for any emergency that may occur. The plan must be in written form. It must explain **who** does **what** and **when** during an emergency.

Be sure that you and your co-workers practice the steps in the emergency action plan frequently. These practice sessions should include the fire department and all affected workers.



Preventing back injuries

Fires, explosions, and toxic gases are important and immediate dangers. **However, the most common hazard for workers working with drums is back injury.**

When handling drums, manual handling may mean lifting, lowering, pushing, pulling, carrying, moving, or holding drums of all sizes. If possible, use the following suggestions to avoid strain injuries:

- Introduce bulk handling to eliminate the use of drums
- Provide and use mechanical handling equipment for drums
- Palletize the drums and use mechanical lifting
- Allocate sufficient space for handling the drums
- Use a drum lifter
- Ask your supplier to provide smaller sized drums
- Clean up floor spills immediately
- Provide unloading ramps
- Provide and maintain even and non-slip floors

The following are lifting guidelines to take into account when working with drums:

1. Place what you will lift as high above the ground as possible.



2. Get the object as close to your body as possible.
3. Position your legs and feet firmly, with your back as straight as possible.

4. Lift smoothly with the arms first, and roll the object over your knee.
Do not jerk.
5. Pull the object as close to you as possible.



6. Stand up with the load, using the legs, placing little or no strain on the back.
7. If you need to turn, do so with your feet. **Do not twist your back, hips, or shoulders.**



8. When lifting a load overhead, make the load lighter, because you cannot use your legs to help you lift.

Samples and Sampling Methods

Sometimes it is required to get a sample of a hazardous waste substance in order to determine what it is (if unknown), concentration and what precautions should be taken when handling the substance. To start, let us define what a sample is.

What is a sample?

A sample is a representative part of the material to be analyzed.

- To be representative, the sample needs to be chosen so that it has and maintains the same qualities as the material being investigated.
- Degradation or alteration of the sample through exposure to air, excess heat or cold, or contaminants from the container must be avoided during collection, transport, and delivery to the analyst (usually a laboratory).
- The number and frequency of sub-samples (samples making up a composite sample) should reflect the nature of the material being sampled.

For example, if the material is thought to be homogeneous (the same throughout), a single sample may be enough. If the sample is thought to be heterogeneous (of varying composition throughout), several samples should be collected at specific time intervals or distances.

Purpose of any sampling program

To produce a set of samples representative of the materials under investigation that are suitable for analysis.

Purpose of hazardous waste sampling

- To gain information to help investigators identify unknown materials.
- To assess the extent to which these materials have become integrated into the surrounding environment.
- To help plan remedial actions.

Types of samples

When discussing types of samples, it is important to distinguish between the type of media to be sampled and the sampling method that gives a specific type of sample. There are two basic types of media samples: the environmental sample and the hazardous sample.

- Environmental samples are generally dilute (in terms of pollutant concentration) samples taken from an area surrounding a spill or dump site (e.g., off-site samples from soils, rivers, lakes, etc.). They usually do not require special handling procedures. However, in certain instances, environmental samples can contain high concentrations of pollutants, and in such cases would have to be handled as hazardous samples.
- Hazardous or concentrated samples are those collected from drums, tanks, lagoons, pits, waste piles, fresh spills, etc. They require special handling procedures because of their potential toxicity or hazard.

There are two important criteria for making the distinction between environmental and hazardous samples:

Personnel safety requirements: Any sample thought to contain enough hazardous materials to pose a safety threat should be designated as hazardous and handled in a manner that is safe for both field and laboratory personnel.

Transportation requirements: Hazardous samples must be packaged, labeled, and shipped according to Department of Transportation (DOT) regulations and Environmental Protection Agency (EPA) guidelines. These regulations (49 CFR parts 171 through 179) describe proper marking, labeling, packaging, and shipment of hazardous wastes. In particular, part 172.402 (h) of 49 CFR is intended to cover shipment of samples of unknown materials destined for laboratory analysis. If there is any doubt about the hazardous nature of a material, the sample should be considered hazardous and shipped accordingly.

Sampling methods

For sampling situations involving hazardous wastes, **grab sampling** techniques are generally preferred because they:

- minimize the time sampling personnel must be in contact with the wastes

- reduce the risks associated with compositing unknowns
- eliminate chemical changes that might occur due to compositing.

Integrated sampling (compositing) is still often used for environmental samples and may be used for hazardous samples under certain conditions (after compatibility tests have been completed).

Sampling Method Selection Criteria

Investigations at hazardous waste sites place more demands on personnel, materials, and methods than those usually found in routine environmental surveys. Thus, the collection of hazardous waste samples will frequently require special equipment and methods. Certain criteria should be considered when selecting a sampling method.

Some important considerations are:

- **Representativeness** — The point of sampling is to collect samples that represent the material of interest. The selected methods, although strongly considering economics, simplicity, versatility, and practicality, must also give a true representation of the situation under investigation.
- **Versatility** — Methods and materials must be useful in a wide range of situations and applications because of the unknown nature of many hazardous waste investigations and environmental spill responses. Versatility, however, should not jeopardize the representativeness of the sample.
- **Ability to Minimize Exposure** — Hazardous waste sampling has the ability to produce both acute and chronic exposure to dangerous, toxic chemicals. Sample methods must be used that minimize personnel exposure.
- **Practicality** — The selected methods should stress the use of simple, practical, proven procedures that can be easily adapted to a variety of situations.
- **Simplicity and Ease of Operation** — Because of the nature of the material to be sampled, the hazards of sampling, and the heavy and uncomfortable safety equipment often required, the sampling procedures selected must be relatively easy to follow. Equipment should be easy to operate, portable, lightweight, rugged, and, if possible, direct-reading.

- Economics - The costs of equipment, manpower, and operational maintenance need to be considered in relation to overall benefit. Instrument durability, disposable equipment, cost of decontamination, and degree of precision and accuracy required should also be considered.
- Safety - The risk to sampling personnel, intrinsic safety of instrumentation, and safety equipment required for conducting sampling all need to be considered in relation to the selection of proper methods and procedures.

Sampling Plan

Before beginning any sampling activities, it is important to identify the purpose of the sampling program, equipment, methods, and logistics to be used by developing a sampling plan. This plan should be developed along with or immediately following the preliminary site assessment.

The plan should be clear and concise and should detail the following basic components:

- background information collected during the preliminary assessment
- objectives and goals of the investigation
- sampling methods to be used, including equipment, procedures, sample containment, and preservation
- justification for selected methods and procedures
- sample locations, including number and types of samples to be collected at each location
- organization of the investigative team
- safety plan (includes safety equipment and decontamination equipment)
- transportation and shipping information
- training information
- additional site-specific information or requirements.

Note that this list of sampling plan elements may be incomplete and that additional component may be added or altered depending on the specific requirements of the field investigation. It should also be noted that although a detailed sampling plan is important, it may be impractical in some situations. For example, emergency responses to accidental spills usually prohibit the development of site-specific sampling plans. In such cases, investigators will have to rely on general guidelines and personal judgment. The sampling plans may then be finalized on site.

In any case, a plan of action needs to be developed, no matter how informal, to help investigators consistently perform their tasks.

Documentation

Field Logbook

All information regarding the investigation must be written in a bound book with consecutively numbered pages. Entries in the logbook must include at least the following:

- Date and time of entry.
- Purpose of sampling.
- Name and address.
- Producer of the waste, and address (if known).
- Type of process producing the waste (if known).
- Type of waste (sludge, wastewater).
- Description of sample.
- Waste components and concentration (if known).
- Number and size of sample taken.
- Description of sampling point.

- Date and time of sample collection.
- Collector's sample identification number(s) and/or name.
- References, such as maps or photographs of the sampling site.
- Field observations.
- Field measurements, such as pH, flammability, or explosiveness.

Notes should be as descriptive as possible. Someone reading the entries should be able to reconstruct the sampling situation from the written information. If anyone other than the person to whom the logbook was assigned makes an entry, he/she must date and sign it.

Photographs

Photographs are the most accurate record of the investigator's observations. They should be taken with a camera-lens system with a perspective similar to that of the naked eye. Photographs can be important during future inspections, informal meetings, and hearings. A photograph must be documented if it is to be for any of these situations. Therefore, for each photograph taken, the following items should be recorded in the field logbook:

- Date and time.
- Signature of photographer.
- Name and identification number of site.
- General direction faced and description of the subject.
- Location on site.
- Sequential number of the photograph and the roll number.

Sample labels

Each sample must be sealed immediately after it is collected. Labels should be written using waterproof ink. Label tags may be filled out before sample collection to minimize handling of the sample containers. The following figures are examples of common sample label or tag formats:

Labels must be firmly attached to the sample containers. Tags may be attached by string when gummed labels are not available or applicable. Be sure that the container is dry enough for a gummed label to be securely attached. The label tag must include at least the following information:

- Name of the collector
- Date and time of collection
- Place of collection and Sample number

Occasionally, sample containers are marked in the field using an etching tool rather than immediately applying a sample label or tag. This avoids possible label contamination problems and decontamination difficulties. In this case, the sample label data are written into a sampling logbook and written onto the label after the sample containers have been decontaminated.

Chain-of-Custody Procedures

Written procedures must be available and followed whenever samples are collected, transferred, stored, analyzed, or destroyed. The main objective of these procedures is to create an accurate written record that can be used to trace the possession and handling of the sample from its collection through its analysis.

A sample is in someone's custody if any of the following conditions are met:

- It is in one's actual possession.
- It is in one's view, after being in one's physical possession.
- It is in one's physical possession and then locked up so that no one can tamper with it.

- It is kept in a secured area, restricted to authorized personnel only.

Sample collection, handling, and identification

The number of persons involved in collecting and handling samples should be kept to a minimum. Final records should be completed at the time the sample is collected and should be signed or initialed, including the date and time, by the sample collector(s). One member of the sampling team should be appointed field custodian. Team members who collect the samples turn the samples over to the field custodian, who then documents each transaction. The sample remains in his/her custody until it is shipped to the laboratory.

Prior to shipping, the sample container should be placed in a transportation case, along with the chain-of-custody record, pertinent field records, and analysis request forms as needed. The transportation case should be sealed or locked to reduce the need for close control of individual samples. In situations when the use of a chest is inconvenient, the collector should seal the cap of the individual sample container in a way that any tampering would be easy to detect.

Transfer of custody and shipment

When transferring the samples, the person receiving the sample must sign and record the date and time on the chain-of-custody record (see figure on the next page). Every person who takes custody must fill in the appropriate section of the chain-of-custody record. To minimize custody records, the number of custodians in the chain-of-possession should be minimized.

All packages sent to the laboratory should be accompanied by the chain-of-custody record and other pertinent forms. A copy of these forms should be kept in the originating office (either carbon or photocopy). Mailed packages can be registered with return receipt requested. For packages sent by common carrier, receipts should be kept as part of the permanent chain-of-custody documentation. Samples to be shipped must be packed so as not to break. The package should be sealed or locked so that any tampering can be easily detected.

Packaging and Shipping

Environmental samples may be packaged following the procedures outlined for samples classified as “flammable liquids” or “flammable solids.” Requirements for marking, labeling, and shipping papers do not apply.

Environmental samples may also be packaged without being placed inside metal cans, as required for flammable liquids or solids. Instead:

- Place sample container, properly identified and with a sealed lid, in a polyethylene bag, and seal bag.
- Place sample in a fiberboard container or metal picnic cooler that has been lined with a large polyethylene bag.
- Pack with enough noncombustible, absorbent, cushioning material to minimize the possibility of the container breaking.
- Seal large bag.
- Seal or close outside container.

Hazardous material samples

Samples not determined to be environmental samples or samples known or expected to contain hazardous materials must be considered hazardous material samples and transported according to the following requirements:

If the material in the sample is known or can be identified, package, mark, label, and ship according to the specific instructions for that material (if it is listed) in the DOT Hazardous Materials Table, 49 CFR 172.101.

For samples of hazardous materials of unknown content, part 172.402 (h) of 49 CFR allows the designation of hazard class based on the shipper’s knowledge of the material and selection of the appropriate hazard class from part 173.2

The correct shipping classification for an unknown sample is selected through the process of elimination, using the DOT classification system. Unless known or demonstrated otherwise (through the use of radiation survey instruments), the sample is considered radioactive and appropriate shipping regulations for “radioactive material” must be followed.

Samples classified as flammable liquids or flammable solids

The following procedure is designed to meet the requirements for “limited quantity” exclusion for shipment of flammable liquids and solids, as described in parts 173.118 and 173.153 of 49 CFR. By meeting these requirements, the DOT constraints on packaging are greatly reduced.

Packaging according to the limited quantity exclusion requires notification on the shipping papers.

A. Packaging

1. Collect sample in a glass container (16 ounces or less), with nonmetallic, Teflon-lined screw cap. To prevent leakage, fill the container no more than 90 percent full at 130 degrees F. If an air space in the sample container would affect sample integrity, place that container within a second container to meet 90 percent requirement.
2. Complete sample identification label tag and attach securely to sample container.
3. Seal container and place in 2-millimeter-thick (or thicker) polyethylene bag, one sample per bag. Place identification tag so that it can be read through the bag. Seal the bag.
4. Place sealed bag inside a metal can and cushion it with enough noncombustible, absorbent material (e.g., vermiculite or diatomaceous earth) between the bottom and sides of the can and bag to prevent breakage and absorb leakage. Pack one bag per can. Use clips, tape, or other means to hold can lid securely, tightly, and permanently.
5. Place one or more metal cans into a strong outside container, such as a metal picnic cooler or a DOT-approved fiberboard box. Surround cans with noncombustible, absorbent, cushioning material for stability during transport.
6. Limited quantities of flammable liquids, for the purpose of this exclusion, are defined as one pint or less.

7. Limited quantities of flammable solids, for the purpose of this exclusion, are defined as one pound net weight in inner containers and no more than 25 pounds net weight in the outer container.

B. Marking/Labeling

1. Use abbreviations only where specified.
2. Place the following information, either hand-printed or in label form, on the metal can:
 - Laboratory name and address.
 - “Flammable Liquid, n.o.s. ID 1993” or “Flammable Solid, n.o.s. ID 1325.”

If the flammable liquid or flammable solid is identified, then “not otherwise specified” (n.o.s.) is not used. Instead, the name of the specific material should be listed before the category (e.g., Acetone, Flammable Liquid) followed by its appropriate UN number found in the DOT hazardous materials table (172,101).

3. Place the following DOT labels (if applicable) on outside of can (or bottle):
 - “Flammable Liquid” or “Flammable Solid.”
 - “Dangerous When Wet.” Must be used with “Flammable Solid” label if material meets the definition of a water-reactive material.
 - “Cargo Aircraft Only.” Must be used if net quantity of sample in each outer container is greater than one quart (for “Flammable Liquid, n.o.s.”) or more than 25 pounds (for “Flammable Solid, n.o.s.”).
4. Place all information on outside shipping container as on can (or bottle), specifically:
 - Proper shipping name.
 - ID or NA number.
 - Proper label(s).

- Addressee and addressor.

(Note that steps 2 and 3 are EPA recommendations, but step 4 is a DOT requirement.)

Print “Laboratory Samples” and “This End Up” clearly on top of shipping container. Put upward pointing arrows on all four sides of container.

C. Shipping Papers

1. Use abbreviations only where specified.
2. Complete carrier-provided bill of lading and sign certification statement (If carrier does not provide, use standard industry form.) Provide the following information in the order listed. (One form may be used for more than one exterior container.)
 - “Flammable Liquid, n.o.s. UN1993” or “Flammable Solid, n.o.s. UN1325.”
 - “Limited Quantity”
 - Net weight or net volume just before or just after “Flammable Liquid, n.o.s. ID 1993” or “Flammable Solid, n.o.s. ID 1325.”
 - Further descriptions such as “Laboratory Samples” or “Cargo Aircraft Only” (if applicable) are allowed if they do not contradict required information.
3. Include chain-of-custody record in the outside container.

D. Transportation

1. Transportation unknown hazardous material samples classified as flammable liquids by rented or common carrier truck, railroad, or express overnight package service.
2. Do not transport by any passenger-carrying air transport system, even if it has cargo-only aircraft. DOT regulations permit regular airline cargo-only aircraft, but difficulties with most suggest avoiding them. Instead, ship by airlines that carry only cargo.

E. Other Considerations

1. Check with laboratory for size of sample to be collected and if sample should be preserved or packed in ice.
2. For overnight package services, determine weight restrictions.



Ergonomics



Outline

1. Ergonomics: Fitting the Job to the Worker
2. Risk Factors
3. Ergonomic Controls
 - Engineering controls
 - Administrative controls
 - Work practice controls
 - Safe lifting techniques
4. Job Evaluation
5. RSI Walkaround Inspection
6. Workplace Pain Survey
7. Computer Workstation Checklist
8. California RSI Regulation
9. Elements of a Comprehensive Ergonomics Program

Objectives

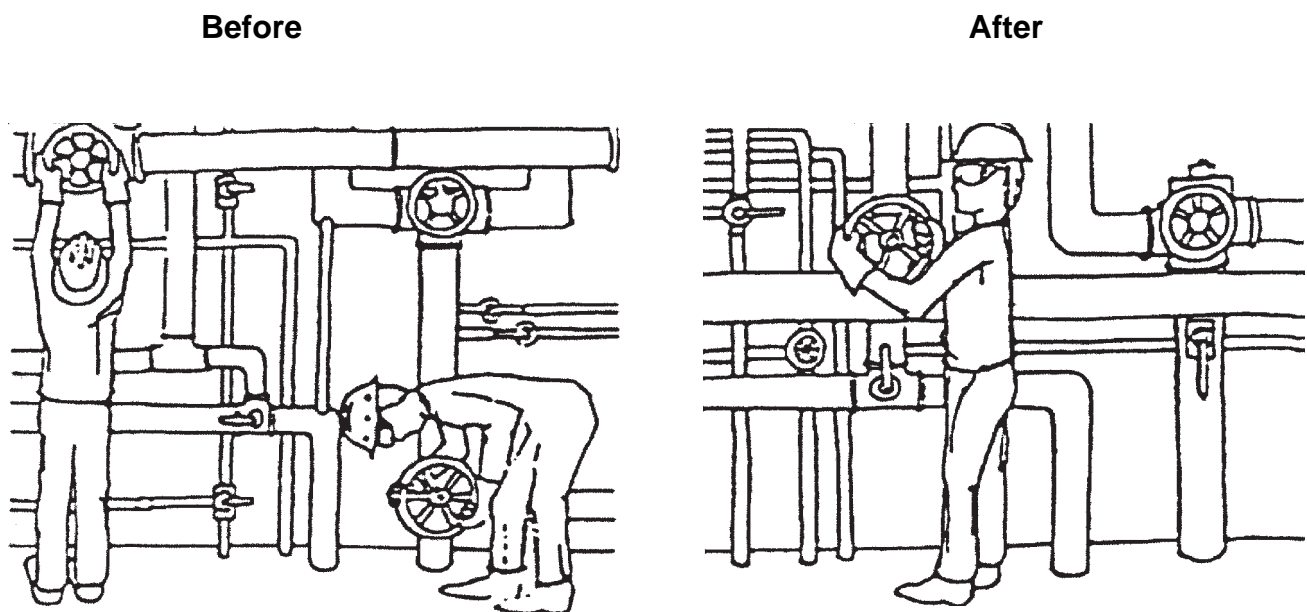
Participants will be able to:

1. Recognize and describe the types of symptoms that can result from ergonomics problems at work.
2. Name the work conditions that can increase the risk of developing an injury.
3. Describe how to change the way in which tasks are carried out in order to reduce the risk of injury.

Ergonomics: Fitting the Job to the Worker

Ergonomics looks at:

1. How people do their work.
2. What body movements and positions they use when they work.
3. What tools and equipment they use.
4. What effect all of these have on their health and comfort.



Fit the Job to the Worker—Not the Worker to the Job!

Ergonomic Risk Factors

Ergonomic risk factors are workplace elements that cause wear and tear on your body and can cause injury. To prevent injuries, you should first identify any risk factors. Once these have been identified, work on finding ways to eliminate them.

RISK FACTORS	DEFINITION	POSSIBLE SOLUTIONS
High Repetition	Performing the same motion over and over.	Redesign the task to reduce the number of repetitions or motions; increase recovery time between repetitions; rotate to different jobs.
Excessive Force	Excessive physical effort needed to do the work—pulling, pounding, pushing. The more effort the harder your body works.	Reduce the exertion needed to accomplish the task; redesign task; assign more staff; use mechanical assists.
Awkward Posture	Bending or twisting any part of your body.	Design tasks, equipment, and tools to keep the body in “neutral” positions.
Static Posture	Staying in one position too long, causing muscles to contract.	Design task to avoid static positions; provide opportunities to change position.
Direct Pressure	Contact of the body with a hard surface or edge.	Improve tool and equipment design to eliminate the pressure, or provide cushioning material.
Vibration	Using vibrating tools or equipment.	Isolate the hand from vibrations.
Extreme Cold/Heat	Cold reduces feeling, blood flow, strength, and balance. Heat increases fatigue.	Insulate the body; control temperature.
Poor Work Organization	Includes: machine paced work, inadequate breaks, monotonous tasks, multiple deadlines.	Reasonable workload, sufficient breaks, task variety, individual autonomy.

- The more risk factors, the greater the chances of developing cumulative trauma.
- By reducing or eliminating the risk factors, the chances of a problem can be lessened.
- Not all employees exposed to these factors will be affected.
- The amounts of exposure (how many motions, at what levels of force) which can cause a disorder are not yet known.
- The longer you are exposed to a risk factor, the greater the chances of injury.

What Are Ergonomic Controls?

Overview: Three Types of Ergonomic Controls

Ergonomic controls are used to help fit the workplace to the worker. They seek to place a body in a neutral position and reduce the other ergonomic risk factors. These controls must accommodate the widest range of personnel.

Ergonomic Controls are grouped into three main categories, in order of the preferred method of preventing and controlling ergonomic risk factors:

1. **Engineering Controls** are the preferred method of control because they are more permanent and effective at eliminating ergonomic risk factors.

Engineering controls include modifying, redesigning or replacing:

- work stations and work areas
- materials/objects/containers design and handling
- tool selection
- equipment

2. **Administrative Controls** deals with how work is structured, such as:

- work scheduling
- job rotation and rest breaks
- exercise programs
- maintenance and repair programs

3. **Work Practices** controls focus on the way work is performed:

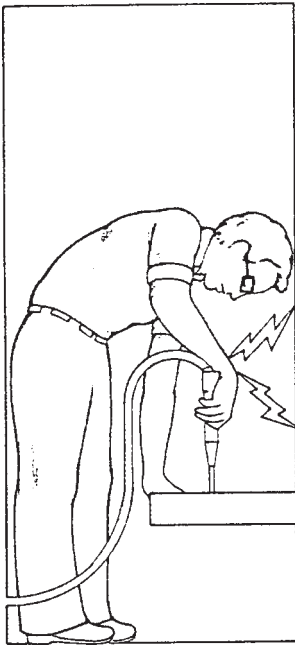
- using proper body mechanics
- keeping the body in neutral positions

Excerpts from: *Ergonomics Awareness Manual – Job Design With the Worker in Mind*. OCAW Local 1-5.

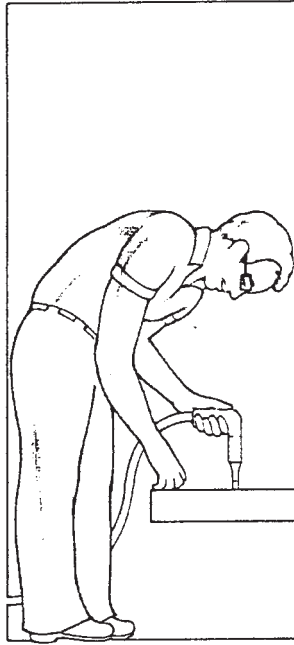
Engineering Controls

Engineering controls are the heart of ergonomics: changing the work place, tools, and equipment to fit the worker. The design should accommodate the wide range of people assigned to the task.

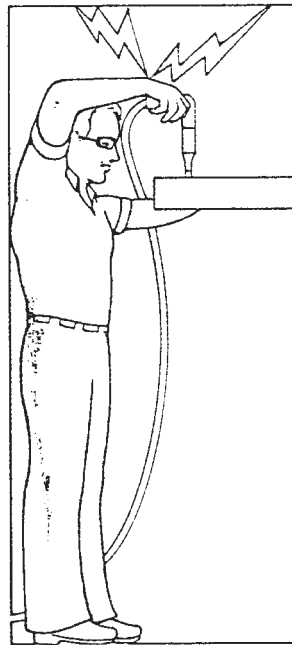
Bad Design



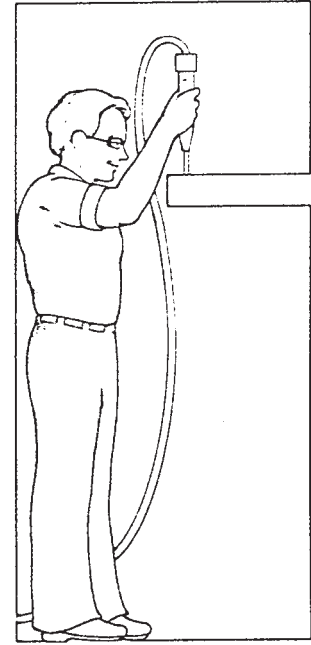
Good Design



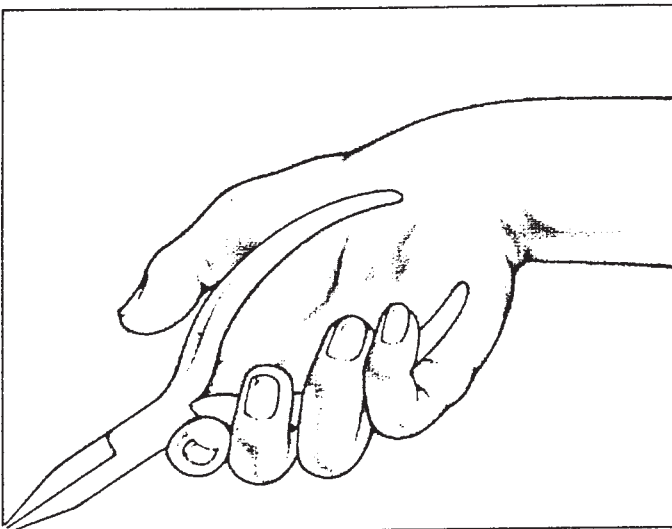
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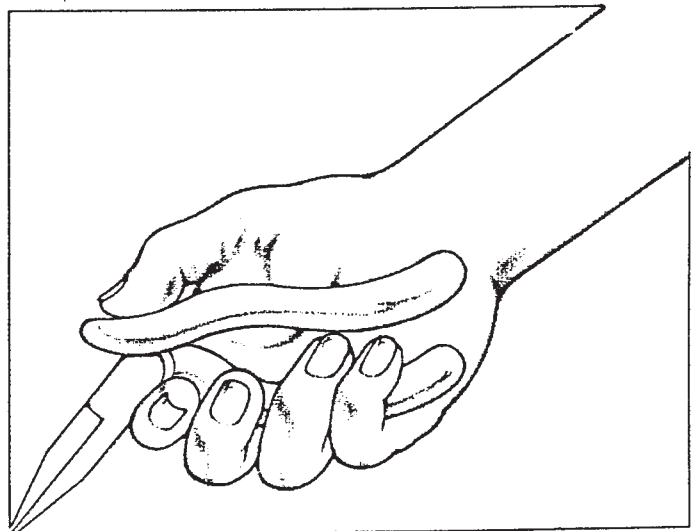
Good Design



Bad Design



Good Design



Administrative Controls

Administrative controls include management and employee policy decisions about the scheduling and structure of work activities. Some examples include:

- **Proper maintenance and housekeeping:**

Proper housekeeping can reduce or eliminate awkward posture associated with extended reaches, bending or twisting when handling materials, tools or other objects. Floor surfaces should be kept free of slipping or tripping hazards.

Poorly maintained power tools can increase vibration. Dull cutting and drilling tools may increase the force required to use them.

- **Job rotation and enlargement:**

This involves rotating workers through different jobs or enlarging jobs to rest the different muscle groups of the body, reduce repetition and reduce mental demands.

- **Work scheduling:**

Work scheduling can help avoid excessive overtime or extended workdays. It should take into account the fact that shiftwork can cause fatigue and thereby increase the risk of ergonomic related injury.

- **Instituting work-rest cycles with adequate recovery time:**

This can reduce fatigue and risk of ergonomic related injury. Short work/break cycles are best to reduce fatigue.

Work Practice Controls

Work practice controls focus on the way work is performed.

Training in safe working postures and techniques is important, along with monitoring to make sure that modified work practices are being used. It is not suggested however that training on proper lifting or carrying is the most effective way to control ergonomic hazards. The use of engineering controls and the elimination of handling materials is the most effective means to reduce or eliminate ergonomic related injuries.

Examples of work practice controls include:

- Modifying work procedures and practices to ensure that neutral working posture and safe work techniques are used.
- Gradual introduction to work for new and returning employees.
- Worker controlled pace and organization to reduce worker fatigue and exposure to risk factors.

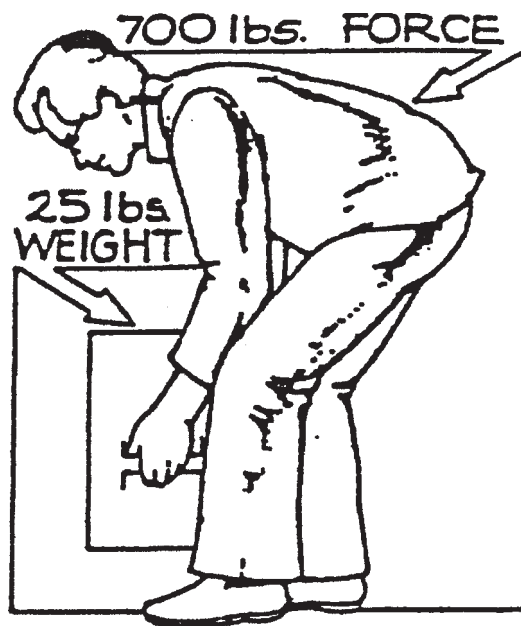
Safe Lifting Techniques

Lifting from the floor can put great strain on your back. For example, lifting a 25 lb. box from the floor requires 700 lbs. of back muscle force. As stated previously, storing materials off the floor can reduce this strain.

However, sometimes this sort of lifting is unavoidable and good lifting techniques must be used.

Rules of Lifting:

- Try out the load first; if it is too bulky or heavy, get help.
- Keep the back straight and lift with the legs.
- Lift slowly and carefully and don't jerk the load around.
- Keep the load as close to the body as possible.
- Remember that putting the load down can be worse than picking it up.
- Don't twist or turn the spine while carrying the load.



How Much is Too Much to Lift?

This question is often difficult to answer because there are many things which affect the degree of difficulty of the lift:

- weight of load
- size of load
- distance from body
- number of times lifted
- stability of load
- adequacy of grip
- nature of lift
 - floor to waist
 - waist to shoulder
 - shoulder to overheads
- obstacles in path
- space constraints
- rest time between lifts
- distance to moved.

Recommendations have been made for maximum loads under various conditions.

Problems with Lifting Techniques

Too much emphasis in the past has been placed on lifting techniques and not enough on changing the workplace. **A program to teach workers the proper lifting techniques should not substitute for workplace redesign to reduce the amount of lifting needed.**

Training programs have tended to be too simplistic and not specific to each work site. Moreover, it is not clear that simple training programs are effective in reducing injuries.

Furthermore, it sometimes takes more energy to lift properly than is worthwhile for the reduction in back stress.

Finally, proper lifting may not protect you completely. For example, under some conditions (such as a box too big to fit between your legs) “lifting with your legs” actually can place greater stress on the back than simply bending over and lifting with your back.

How Do You Conduct a Job Evaluation?

Break the work down into the smallest pieces possible so that your evaluation can be specific and detailed.

The evaluation should include three parts:

- A. Job description
- B. Observation and measurement (checklist)
- C. Worker symptoms (survey/interviews)

A. Job Description

Collect information to fully describe each specific task, job, workstation, tool, and/or piece of equipment you will evaluate.

Include:

- job name and location
- number of people involved and job titles
- work activities or tasks involved
- equipment and tools used
- production requirements
- work schedule
- general work environment

B. Observation and Measurement

Use direct observation, videotapes, photos and sketches of the workstation to identify risk factors.

Look at:

- how people move
- positions people work in
- how long people perform specific activities
- weights of objects handled or moved
- dimensions of workstations, tools, and equipment
- temperature of work area.

The most effective way to record this information is to use an ergonomic checklist.

C. Worker Symptoms

When conducting the evaluation be sure to ask workers:

- whether they experience pain or discomfort while performing the job, and
- what activities trigger that pain.

The relationship between pain or discomfort and specific activities can assist in pinpointing tasks, workstations, equipment, or tools which may be causing or aggravating ergonomic-related injuries. You can gather this information either through individual interviews or through employee questionnaires or symptom surveys.

Controlling Risks Worksheet

Job Title/Trade:

Task Being Analyzed:

List the tools used for this task:

List materials used for this task:

Describe the task, step by step:

Risk Factors	Body Area Affected	Solutions

RSI Walkaround Inspection Checklist

The following checklist will give you an idea of what to look for when inspecting the workplace for RSI risk factors. Each job should be observed to see whether the worker is at risk for RSI. Talk to the worker(s) performing the job and ask them the questions below.

In the checklist below, questions that are answered “Yes” suggest a potential problem with the job.

Walkaround date: _____ Time: _____

Job or Workstation (add name of machine if applicable): _____

Department: _____

Worker’s name: _____

Check YES or NO

GENERAL

YES NO

- Does the job require the repetitive use of the same body part for extended periods of time?
- Does the employer offer any piece work or bonus incentives? Are there any sort of production quotas?

WORK STATION DESIGN

YES NO

- Does the worker do all (or most) of his or her work while seated?
- Is the worker’s chair seat or back support fixed (i.e., not adjustable)?
- Does the worker have too little leg room? Are the knees and legs uncomfortable?
- Does the worker do all (or most) of his or her work while standing?
- Is the height of the equipment or work surface that the worker is using too high or too low for the work being performed?
- Is the height of the work station fixed (i.e., it can’t be adjusted)?

TOOL DESIGN

YES NO

- Does the worker frequently have to bend his or her wrist when using tools?
- Are the hand grips on tools too large or too small for the person using them?
- Does the worker use tools that put direct pressure on the palm of the hand?
- Does the worker use tools that vibrate?

WORK PROCEDURES: BACK, SHOULDER, NECK

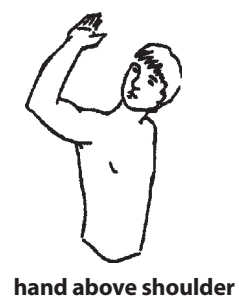
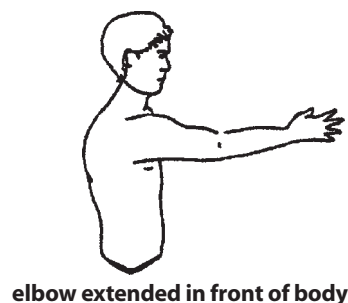
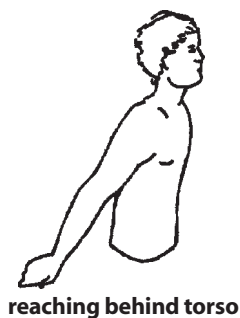
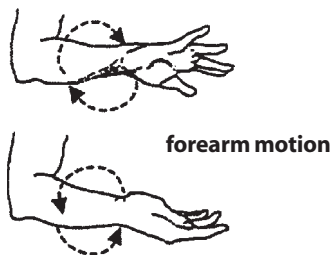
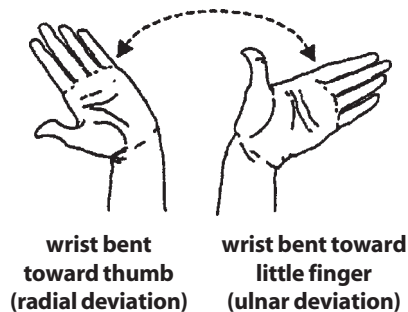
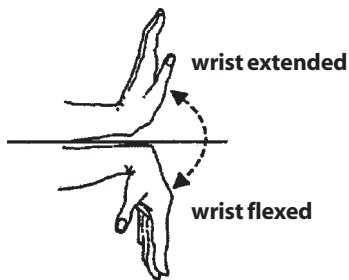
YES NO

- Does the worker have to lift heavy loads?
- Does the lifting involve high or low lifts?
- Does the worker have to twist around when lifting loads?
- Does the worker have to carry heavy loads?
- Are materials that have to be moved difficult to grip or hold?
- Does the worker have to push or drag heavy loads?
- Is the floor slippery or uneven?
- Does the worker have to bend or twist frequently at the waist?
- Does the worker have difficulty reaching all the controls or parts?
- Does the job require working with a bent neck?
- Does the worker have to hold an awkward posture for long periods of time?
- Does the worker have to reach in front or behind?

WORK PROCEDURES: WRISTS, HANDS, FINGERS

YES NO

- Does the worker have to push or pull products or parts forcefully with the hands or wrists in an awkward or bent position?
- Does the worker have to hold an awkward posture for a long period of time?
- Does the worker have to pick up heavy objects with his or her hand(s)?
- Does the worker have to lean the wrists or forearms on a sharp edge of a table for a long period of time?
- Does the worker need a lot of finger strength to manipulate objects?
- Does the worker wear loose-fitting gloves when grasping objects?
- Does the worker's job involve frequent or continuous keyboard work?
- Does the worker frequently use any of the following work positions? (Circle the positions used)



Workplace Pain Survey

Return this survey to: _____

Name: _____ Phone: _____ Date: ___/___/___

Male Female Right handed Left handed

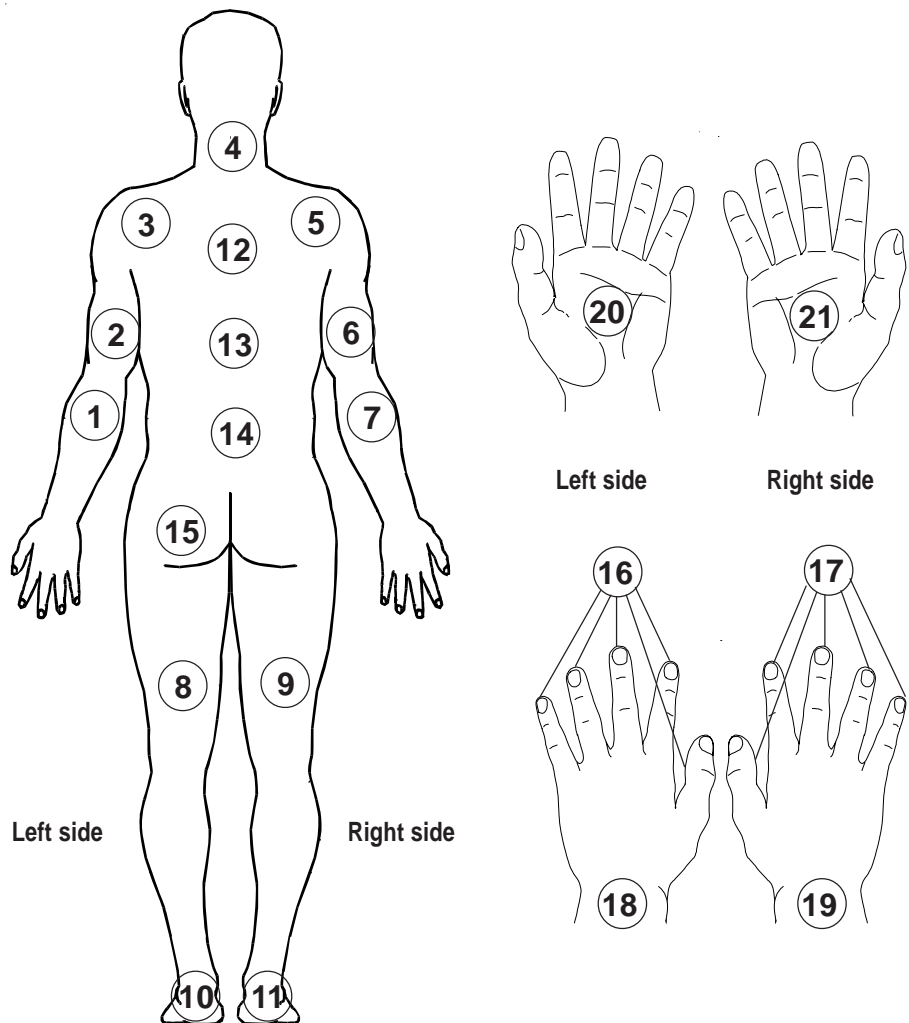
Employer/department: _____ Job title: _____

Main job activities: _____

1. Have you had any pain or discomfort during the past year which you feel might have been caused or made worse by your work?

- YES If YES, please shade the circle in the part of the body affected.
 NO If NO, please stop here.

1. Left elbow
2. Left upper arm
3. Left shoulder
4. Neck
5. Right shoulder
6. Right upper arm
7. Right elbow
8. Back of left thigh
9. Back of right thigh
10. Left foot
11. Right foot
12. Upper back
13. Middle of back
14. Lower back
15. Buttocks
16. Fingers on left hand
17. Fingers on right hand
18. Left wrist
19. Right wrist
20. Left palm
21. Right palm
22. Other (please shade area and describe)



2. What part of your job do you think causes your pain or discomfort?

3. What time does your discomfort usually occur? *(Check all that apply.)*

Morning Afternoon Evening Night

4. Do any of these symptoms wake you up at night? YES NO

If YES, what are the symptoms? _____

5. Does the pain or discomfort interfere with routine activities (such as eating, driving, walking, cooking, etc.)? YES NO

6. Did this problem begin before or after you started your current job? Before After

7. Have you visited your doctor about this pain or discomfort? YES NO

If YES, please detail the diagnosis or treatment: _____

8. Have you had to take time off work in the last year because of this pain or discomfort? YES NO

How much? _____ When? _____

9. Do any co-workers experience similar pain or discomfort? YES NO

How many? _____

10. Did you report this injury to your supervisor or anyone else in management? YES NO

If yes, what happened? _____

If no, why not? _____



COMPUTER WORKSTATION CHECKLIST

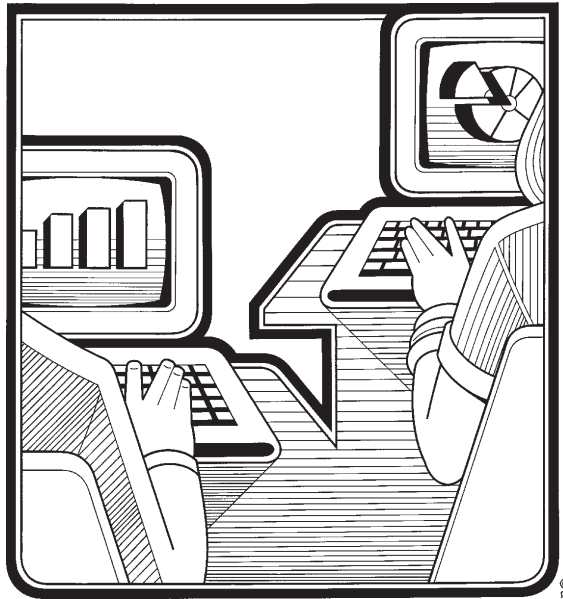
Each user should fill out a separate copy of this checklist.

User Name: _____

Phone: _____ Date: _____

Hours per day spent working on a computer: _____

Description of computer job tasks: _____



—Adapted by the Labor Occupational Health Program from a checklist developed by the Occupational Health Service at UC Berkeley

✓ Chair Adjustment

	YES	NO
● Is your chair height adjustable?	_____	_____
● Does your chair support your lower back?	_____	_____
● Is there room between the front edge of the seat pan and the back of your knees?	_____	_____
● Can you easily reach your work without interference from the arms of your chair?	_____	_____
● Are your arms and shoulders relaxed and not forced into an awkward position by chair arms?	_____	_____
● Do your feet rest flat on the floor or footrest with your knees bent at approximately 90 degrees?	_____	_____

**—IF YOU ANSWER "NO" TO ANY OF THE ABOVE QUESTIONS
YOU MAY NEED ERGONOMIC MODIFICATIONS—**

Sitting with your feet flat on the floor (or on a footrest) will help support your spine. Having your thighs parallel to the seat with knees bent at approximately a 90 degree angle, and having adequate clearance behind your knees, will keep the chair from interfering with the circulation to your legs.

If the back of your chair is adjustable, raise or lower it so that the contour of the chair provides maximum lumbar (lower back) support. If possible, adjust the tilt of the back rest to support your body in an upright position. A slight angle, either forward or back, is also acceptable. Adjust the chair according to what is most comfortable for you.

If your chair has arms, they should allow you to get close to your work without getting in the way. Chair arms should not force you to elevate your shoulders or hold your arms out to the side.

Recommendations

- New chair, adjustable for height and tilt of seatpan and backrest. Computer users should be able to adjust chairs from seated position without use of tools. Armrests, if provided, should be removable.
- Another chair swapped from within the department.

- Lumbar support cushion if chair does not provide adequate lower back support.
- Footrest if computer user's feet do not rest firmly and comfortably on the floor.
- Other (*please describe:*)

✓ Work Surface/Keyboard Adjustment

	YES	NO
● With your chair adjusted properly, is your keyboard at approximately elbow level?	_____	_____
● Are your arms resting at your sides rather than stretched out in front of you?	_____	_____
● Are your shoulders relaxed and not elevated when you work at your work surface?	_____	_____
● When typing or writing at your work surface, are your forearms parallel to the floor, and your wrists in a straight, neutral position?	_____	_____
● Are there at least two inches of clearance between the bottom of your work surface and the top of your thighs?	_____	_____

**—IF YOU ANSWER "NO" TO ANY OF THE ABOVE QUESTIONS
YOU MAY NEED ERGONOMIC MODIFICATIONS—**

Ideally, with your arms resting comfortably at your sides, the home row of your keyboard (the row with the letters a, s, d, etc.) should be at approximately elbow level. If your work surface is adjustable, start by adjusting your chair so that your feet rest on the floor. Once that's at the proper height, adjust the work surface. If your work surface is too high and cannot be adjusted, adjust the chair to bring your elbows to the home row level of the keyboard and support your feet with a footrest if necessary.

Recommendations

- A bi-level table, easily adjustable for screen and keyboard height.

- A lower or higher table swapped from within the department.
- A height adjustable keyboard and mouse tray that can be attached to existing desk or table.
- A chair that is height adjustable; may need to provide footrest.
- Other (*please describe:*)

✓ Monitor Adjustment

	YES	NO
● Is the viewing distance to your computer monitor somewhere between 16 and 24 inches?	_____	_____
● Is the top of your computer screen at or just below eye level?	_____	_____
● If you wear bifocals or trifocals, are you able to look at the monitor without tilting your head?	_____	_____

**—IF YOU ANSWER "NO" TO ANY OF THE ABOVE QUESTIONS
YOU MAY NEED ERGONOMIC MODIFICATIONS—**

Once your chair and work surface are properly adjusted, adjust your computer monitor so that the top of the screen is at or just below eye level.

People who wear bifocals or trifocals often end up tilting their heads back to read through the lower portion of their glasses. This can sometimes lead to neck, shoulder, and back discomfort. Lowering the computer monitor slightly, or purchasing glasses specifically designed for the viewing distance to your terminal screen, can help alleviate this problem.

Recommendations

- Bi-level table, adjustable for screen and keyboard height.
- Raise monitor by putting it on top of the computer, on a platform, on boxes, or on books.
- Lower monitor by removing it from the top of the computer or other platform.

- Swinging, adjustable monitor arm.
- Eye exams and special viewing glasses, if necessary.
- Other (*please describe:*)

✓ Workstation Accessory Adjustment

	YES	NO
● Are your input devices (mouse, trackball, digitizing tablet) at the same level as your keyboard?	_____	_____
● Are your primary work materials and input devices located in front of you?	_____	_____
● Do you have enough room on your work surface for all your computer accessories?	_____	_____
● Are you able to keep your arms from resting on any hard or square edges on your work surface?	_____	_____
● Do you avoid cradling the phone between your ear and shoulder?	_____	_____

**—IF YOU ANSWER "NO" TO ANY OF THE ABOVE QUESTIONS
YOU MAY NEED ERGONOMIC MODIFICATIONS—**

Work surfaces often don't allow enough space for computers and related accessories. Keyboard trays or similar devices can increase desk space, but be sure they are wide enough to accommodate your mouse, trackball, etc. and don't cut down on your leg room.

As you change tasks, remember to move primary materials and input devices in front of you. If you look at reference materials as you type, use a document holder or slant board placed at the same height and distance as your monitor.

A wrist or forearm support can help you maintain your forearms, hands, and wrists in a straight and neutral position. This helps relieve the strain on your shoulders and back. It also keeps your wrists from resting on the table edge. A wrist rest should be made of a soft foam and constructed so that the pad height matches the front height of your keyboard.

Talking on the phone with the receiver cradled between your ear and your shoulder can cause neck, shoulder, and back pain. A headset will allow you to maintain your spine in alignment while talking on the phone.

Recommendations

- Surface large enough for keyboard, mouse, etc.
- Padded wrist or forearm support for keyboard and mouse use.
- Document holder that is adjustable to screen height.
- Telephone headset.
- Other (*please describe:*)

✓ Glare Reduction

	YES	NO
● Is your computer screen free of glare?	_____	_____
● Is your overhead lighting adjustable?	_____	_____
● Is your computer screen at a right angle to the window?	_____	_____
● Are window coverings available?	_____	_____
● Is task lighting (desk lamp, etc.) available?	_____	_____
● Is a glare screen available?	_____	_____

**—IF YOU ANSWER "NO" TO ANY OF THE ABOVE QUESTIONS
YOU MAY NEED ERGONOMIC MODIFICATIONS—**

To control glare, first identify where it is coming from. Glare can come from windows, indoor lighting, and reflective surfaces. Once you identify the source there are several possible ways to block it.

You could:

- Position the terminal so neither the screen nor your eyes are facing the light source
- Install window coverings
- Turn overhead lights down or off
- Use individual desk lamps instead of overhead lights.

If you can't eliminate glare at the source, glare screens can also be helpful.

Recommendations

- Use blinds or curtains over windows when necessary.
- Position monitor to avoid direct light in user's eyes or on user's screen.
- Position monitor screen to be at right angle to window.
- Install dimmer switches for overhead lighting.
- Turn off some lights; use task lighting such as desk lamps, if needed.
- Remove some fluorescent tubes if necessary.
- Use a glare screen.
- Other (*please describe:*)

✓ Work Practices

	YES	NO
● Do you take short and frequent breaks throughout the day to reduce fatigue?	_____	_____
● Do you frequently change your body position while working?	_____	_____
● Do you provide your eyes with 10 second mini-breaks every 15–20 minutes?	_____	_____

	YES	NO
● Do you work fairly regular hours without a lot of overtime?	_____	_____
● Are you able to complete your daily workload and meet deadlines without excessive stress?	_____	_____
● Are you able to set your own work pace?	_____	_____
● Do you work on tasks away from the computer for some portion of the day?	_____	_____
● Have you received adequate training in how to use the computer?	_____	_____

**—IF YOU ANSWER "NO" TO ANY OF THE ABOVE QUESTIONS
YOU MAY NEED ERGONOMIC MODIFICATIONS—**

Regular breaks help to alleviate fatigue and strain to your eyes and upper body. Changing position periodically helps maintain circulation and prevents putting pressure on any one area of the body for an extended period of time.

It is also important to consider how the job itself is designed. Healthy jobs include varied tasks and reasonable work loads.

Recommendations

- Regular rest breaks.
- Varied job tasks.
- Reasonable job demands.
- Elimination of electronic monitoring and computer-paced work.
- Adequate training.
- Other (*please describe:*)

✓ Priority Recommendations

Reviewing all of the recommendations listed on the previous pages, the top 3 priorities are:

1. _____

Why? _____

2. _____

Why? _____

3. _____

Why? _____

California's Regulation on Repetitive Motion Injuries

Employers must take action to prevent repetitive motion injuries, according to a unique California regulation.

But, the regulation is only triggered if:

- Two workers have reported repetitive motion injuries within a 12 month period.
—and—
- These injuries must come from identical work and are diagnosed by a physician.

THEN the employer must establish a program to minimize repetitive motion injuries:

1. Evaluate work activities that are stressful to the body.
2. Implement controls such as redesigning the workstation, adjusting tools, rotating jobs, slowing down the pace of work.
3. Train workers on the symptoms and causes of repetitive motion injuries, the importance of early reporting and diagnosis, and the methods used to control or reduce the problem.

It is very important that workers report injuries and be evaluated by reputable physicians for proper diagnosis.

The regulation can be found in Title 8, California Code of Regulations, General Industry Safety Orders §5110. The regulation is enforced by Cal/OSHA listed in the telephone directory as the California Division of Occupational Safety and Health, with offices in most local areas.

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Produced by University of California, Los Angeles; Labor Occupational Safety and Health Program.

They're Your Rights, Use Them!

Elements of a Comprehensive Ergonomics Program

1. Management Commitment
2. Worker Involvement
3. Organizational Structure – Ergonomics Team
4. Training and Education
5. Worksite Analysis
6. Hazard Prevention and Control
7. Medical Management
8. On-going Program Evaluation





Respiratory Protection

Half-Mask APR



Full-Face APR



Full-Face PAPR



Full-Face Air Supplied



Outline

1. Respirators: The Last Resort
2. Cal/OSHA Requirements for a Respiratory Protection Program
3. Explanation of Respiratory Terms
4. Classes of Respirators
5. Air Purifying Respirators—Clean the Air Before You Breathe It
6. Supplied Air Respirators—Importing Your Own Fresh Air
7. Fit-Testing
8. Maintenance of Respirators

Objectives

Participants will be able to:

1. Explain why respirators are considered to be the last resort for workers protection.
2. List the main components of the Cal/OSHA Respirator regulation.
3. Recognize the difference between the two classes of respirators: APR and SAR
4. Describe the connection between PELs and type of respirators (Protection Factors)
5. Describe a qualitative fit test; demonstrate a daily negative and positive fit check.

Respirators—The Last Resort

Respirators are very limited as control devices and their use must be carefully monitored. Respirators:

- are hot and uncomfortable
- often fit poorly, allowing you to breathe in the toxic substance
- put extra stress on the heart and lungs
- do not prevent skin exposure
- limit conversation and therefore safety
- do not stop the toxic material from getting into the environment



In a sense, wearing a respirator to stop a chemical exposure is like wearing a bullet proof vest to stop a bullet.

Since respiratory protection is the control of last resort, Cal/OSHA requires that harmful exposures to chemicals be controlled by engineering means whenever feasible. These include: ventilation; isolation of the process; and substitution of a less toxic agent. If engineering controls are not feasible or adequate, exposures may be controlled by administrative means such as limiting the amount of time that a worker is exposed. Control of chemical exposures which are above the PEL through the use of respirators is only permitted when:

- engineering controls are being implemented
- engineering and/or administrative controls don't achieve full compliance
- emergency protection against occasional and/or relatively brief exposure is needed

Cal/OSHA Requirements for a Respiratory Protection Plan (GISO 5144)

When other methods of control (engineering, administrative) are not possible or adequate, respirators should be used. According to Cal/OSHA, companies that use respirators must have the following:

1. A written Respiratory Protection Program covering the use of respirators during normal and emergency operations.
2. Selection of respirators based on the hazard.
3. Annual training in the hazards of improper use of the respirator, limitations of the respirator, procedures to use in emergency and malfunction situations, how to properly inspect, put on and remove the respirator, how to clean and store the respirator and how to recognize medical symptoms that would prevent you from being able to use the respirator.
4. Annual fit-testing of every worker who wears a negative pressure respirator for the make, model and size of the respirator worn.
5. Routine cleaning and disinfection of respirators.
6. Storage to protect from contamination, heat, and mechanical damage.
7. Replacement of worn parts.
8. Inspection of respirators used for emergencies at least once a month and after each use. Self-contained breathing apparatus (SCBA) must be inspected every month whether they are used for emergencies or not.
9. Periodic surveillance of the work area including exposure monitoring.
10. Program evaluation at least annually.
11. Use of NIOSH approved respirators and cartridges.
12. Approval of a licensed physician or other licensed health care professional (LHCP) of the medical status for all workers who are required to use a respirator.
13. Breathing air quality must be checked and verified to not be contaminated where air-supplying respirators are used.

Safety & Health Fact Sheet



July 2000

Cal/OSHA Consultation Service

California Department of Industrial Relations
P. O. Box 420603 ■ San Francisco, CA 94142-0603

Revised Respirator Regulation

Cal/OSHA's revised regulation for worker use of respirators took effect November 1998. Section 5144 in Title 8, California Code of Regulations, details steps employers must take to assure safe and effective use of respirators in the workplace.

The revised regulation contains many new provisions. However, it is important to start with the requirements related to the most serious hazards in your workplace first.

The revised regulation applies to all workplace respirator use except tuberculosis (see Section 5147). Also, substance-specific standards (e.g. lead, asbestos, carcinogens) now reference parts of Section 5144. (Firefighters: see also Section 3409.)

Before resorting to use of respirators, hazardous airborne exposures must be controlled as far as feasible by engineering and work practice controls.

The Cal/OSHA respirator regulation can be accessed at the Division of Occupational Safety and Health section of the California Department of Industrial Relations website: <http://www.dir.ca.gov>

Elements of the comprehensive respirator program required of employers:

- All procedures in written form
- Selecting appropriate respirators
- Medical evaluation of respirator users
- Annual face seal fit testing
- Procedures for routine and emergency use
- Respirator cleaning and disinfection, storage, inspection, maintenance and repair
- Air quality for supplied air devices
- Annual employee training
- Periodic program evaluation

Getting Help

Improper use of respirators can result in worker injury and illness, fines and job shutdowns. For help in complying with Section 5144, contact:

Cal/OSHA Consultation Service

Employers can request at no cost an industrial hygienist to come to their worksite to determine if respirators are needed and which ones to use. The Consultation Service is independent of Cal/OSHA's enforcement unit and can be reached at:

Fresno 559-454-1295	San Bernardino 909-383-4567
Oakland 510-622-2891	San Diego 858-467-4071
Sacramento 916-263-0704	Santa Fe Springs 562-944-9366
	Van Nuys 818-901-5754

Or toll-free **1-800-963-9424**

Important changes in the revised regulation:

- Voluntary use: provisions where employees use respirators and dust masks as a voluntary precaution. 5144(c)(2)
- Qualified program administrator required. 5144(c)(3)
- Atmospheres immediately dangerous to life or health: detailed specification of acceptable respirators. 5144(d)(2)
- End-of-service-life indicators: required for chemical cartridges, or the employer must have data showing acceptable change-out times. 5144(d)(3)(C)2.
- Employee medical evaluations: required prior to first use of a respirator, as well as follow-up medical examinations and allowing employees to discuss their medical questionnaire results with the administering health care provider. 5144(e)
- Powered air-purifying respirators: to be provided to employees unable to wear a negative pressure respirator for medical reasons. 5144(e)(6)(B)
- Annual face seal fit testing with test atmosphere: acceptable methods of fit testing are detailed in Appendix A. Fit testing is now also required for tight fitting air-supplied respirators. 5144(f)
- Facepiece seal checks: each time a tight fitting respirator is put on, its user must perform a seal check as specified in Appendix B-1. 5144(g)(1)(C)
- Atmospheres that may be immediately dangerous to life or health: detailed precautions to be taken. 5144(g)(3)
- Annual employee training: employees must be able to demonstrate knowledge and skills specific to the hazards and uses of respirators in their particular workplace, including emergency use. 5144(k)
- Ongoing respirator program evaluation: including periodic consultation with employees. 5144(l)

Internet resources

- Cal/OSHA <http://www.dir.ca.gov>
- Federal OSHA <http://www.osha.gov>
- NIOSH publications <http://www.cdc.gov/niosh> or phone 1-800-356-4674

Explanation of Respiratory Terms

Before you use a respirator, you should have answers to the following questions:

- What's the hazard?
- What form is it in?
- What's the maximum anticipated concentration?
- Can the contaminant be engineered out?
- What are the health effects?
- Is it an eye irritant?
- Can it be absorbed through the skin?

If you need to wear a respirator, some key terms to help you understand your options are explained below.

Respirator Hazards—What are you protecting yourself from when you wear a respirator?

- DUSTS - small solid particles (e.g. wood dust)
- MISTS - small liquid droplets (e.g. acid mist)
- FUMES - very small solid particles (e.g. welding fumes)
- VAPORS - evaporated liquids (e.g. solvent vapor)
- GASES - e.g. hydrogen sulfide, carbon monoxide
- OXYGEN DEFICIENCY

IMMEDIATELY DANGEROUS TO LIFE AND HEALTH (IDLH) - an atmosphere in which exposure to a contaminant can cause:

- Serious injury or death within a short time
- Irreversible or delayed health effects, such as cancer

OXYGEN DEFICIENCY – an atmosphere which contains less than 19.5 % oxygen at sea level. Air normally contains 21% oxygen at sea level.

Types of Respirators

1. Air Purifying Respirator (APRs):

- Contain filters, cartridges, or canisters which serve as barriers between the wearer and air contaminants.

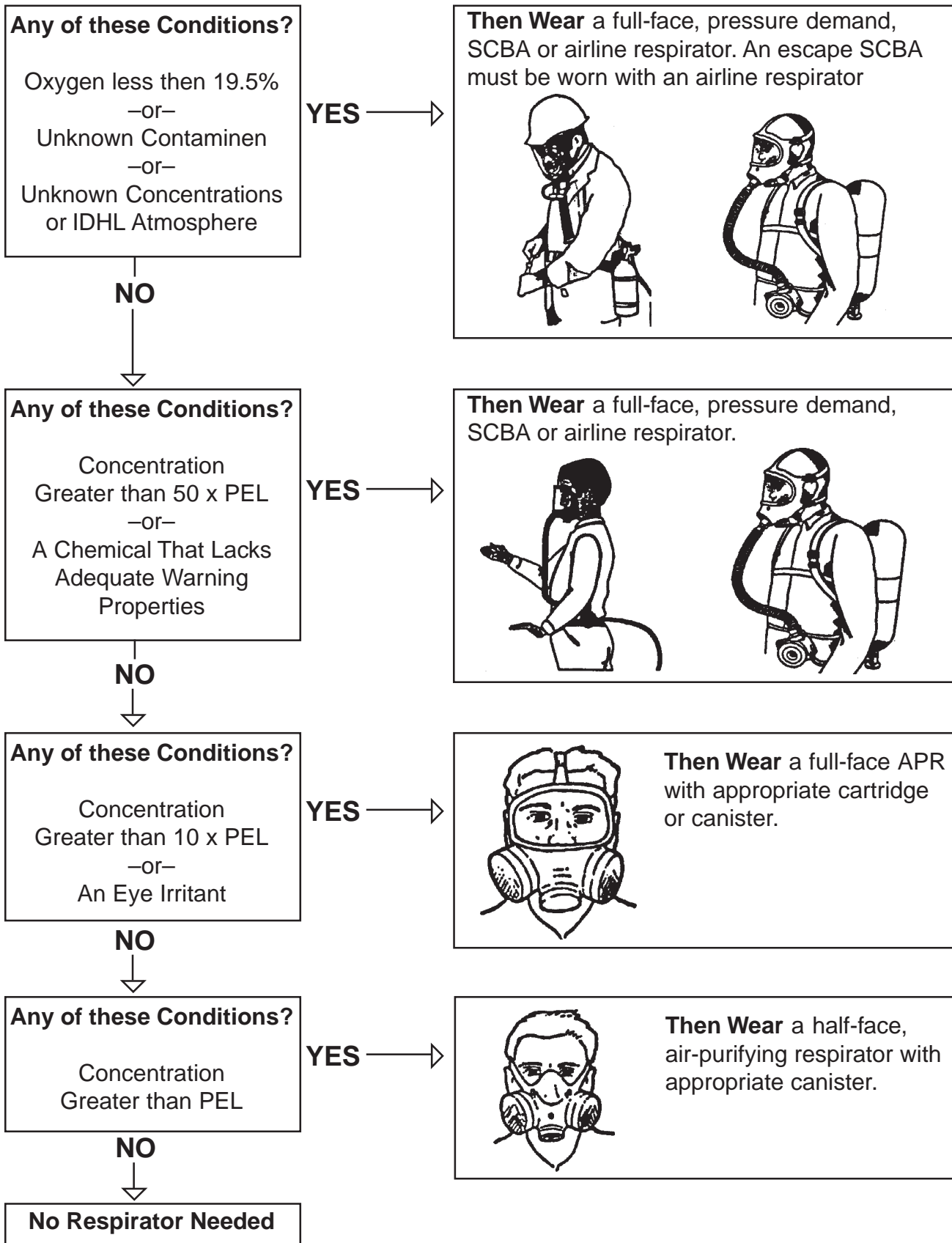


2. Supplied Air Respirators (SARs):

- Excludes the contaminated or oxygen deficient air altogether by providing clean air from an independent source.
- Used under the following conditions:
 - a. Excessive concentrations of contaminants
 - b. Unknown contaminants or unknown concentrations of contaminants
 - c. Not enough oxygen



Choosing a Respirator



Types of APRs

There are two main classes of respirators which may be a part of your personal protective equipment: Air Purifying Respirators (APRs), and Supplied Air Respirators (SARs). APRs are respirators that use filters or cartridges to filter the air that you breathe. They **do not** supply air. The air enters the respirator when the wearer inhales, thereby creating a negative pressure in the facepiece. The contaminated air passes through the air purifying elements of the respirator (filter or cartridge), theoretically delivering purified air inside the facepiece.

APRs can be grouped according to **type of facepiece** and according to **type of air purifying element**.

Facepiece

Half-mask Facepiece

These respirators offer respiratory protection from certain chemicals, but they do not provide eye protection. The facepiece covers the nose and mouth and the lower sealing surface is under the chin. The two basic types are:

- replaceable filters/cartridges
- disposable/single use respirators



Most disposable/single use respirators are designed to protect only against certain particulates (dusts, mists, fumes) and will **not** protect against gases, vapors or asbestos fibers.

Full Facepiece

These respirators offer respiratory protection from certain chemicals. They have a more reliable seal in addition to providing eye and greater skin protection.

They are used with replaceable filters, cartridges or canisters.



Powered Air Purifying Respirator (PAPR)

- PAPR facepieces can be full face-mask, half-mask, hood, or helmet.
- A blower is used to pass contaminated air through a filter, cartridge, or canister.
- Advantages: less breathing resistance, and leakage is more likely to be outward because air is supplied at a positive pressure.
- Disadvantage: air purifying elements may get used up faster due to increased air flow.



Types of Air Purifying Elements

Filters

Filters are used to protect against dust, mist, and fume particles. They work by trapping the contaminant particles in a fibrous material. They do not provide protection against gases and vapors. It is important to use the appropriate filter for the specific type of contaminant:

- 3 types: Dust; Dust & Mist; Dust, Mist & Fume.
- Some single use respirators are referred to as dust masks. They are less protective and can only be used for certain dusts and mists.
- Disposable and single-use respirators should not be used if the original contour or shape has been altered due to damage from crushing, bending, etc.
- HEPA (high efficiency particulate filter): used for highly toxic dusts (required for asbestos and lead).
- Filters should be changed when it becomes more difficult to breathe.



Cartridges and Canisters

Both cartridges and canisters are used with air purifying respirators to remove gases and vapors from contaminated air. A variety of absorbents, such as activated carbon, are employed to remove the air contaminants. Canisters generally have a larger capacity than cartridges and may provide more protection in more highly contaminated environments.



- Cartridges and canisters are designed to provide protection against specific gases and vapors (ammonia gas, formaldehyde, etc.) and classes of gases and vapors (acid gases, organic vapors, etc.). Cartridges/canisters appropriate for the contaminant must be used.
- Canisters are usually used with a full-facepiece respirator, in which the canister is mounted at the chin of the respirator or on the wearer's chest or back via a harness. This combination is referred to as a "gas mask."

The ability of cartridges to remove air contaminants varies greatly with:

- a) the specific gas or vapor
- b) the concentration
- c) the breathing rate of the wearer
- d) other factors such as humid or dry air and shelf life

Cartridges should be replaced daily, after each use, or if break-through has occurred.

ALWAYS USE APPROPRIATE CARTRIDGE FOR THE SPECIFIC CONTAMINANT

Combination Filter/Cartridge

If you need protection against particulates **and** a vapor or gas, combination cartridge/filters are available and must be used. Be sure to use the cartridge/filter which is specific to the contaminants you are protecting against.

ALWAYS READ THE LABEL ON ALL AIR PURIFYING ELEMENTS TO DETERMINE THE SPECIFIC CONTAMINANTS WHICH THEY WILL PROTECT AGAINST.

Particulate Respirator Cartridges/Filters

If you wear a respirator to protect against particulates such as metal dusts or paint sprays, there is a new line of respirator filters you must use. NIOSH has updated its certification standard for respirators in order to take advantage of technological improvements in methods used for testing particulate filters. The standard creates three new series of particulate filters. These are designated as N, R, and P. Each of these series will have three minimum filter efficiency levels—95, 99, and 99.7%.

Filter Series	Minimum Filter Efficiency	Designation
N – Use when only solid and water-based particulates are present in the work environment. Examples include metal dusts and water-based paint surveys	95% 99% 99.7%	N95 N99 N100
R – Use when oil particulates are present and filter will be used for only one shift. Examples include lubricants and cutting fluids.	95% 99% 99.7%	R95 R99 R100
P – Use when oil particles are present and filter will be used for more than one shift. Examples include lubricants and cutting fluids.	95% 99% 99.7%	P95 P99 P100*

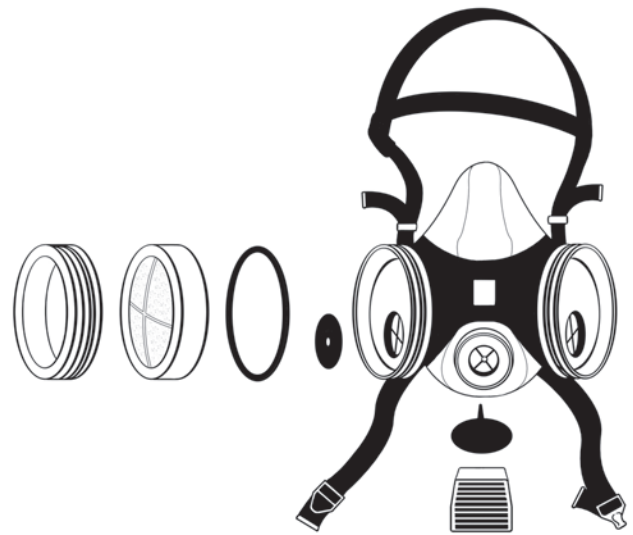
**The P100 filter is equivalent to the HEPA filter.*

When used properly, the N- and P- series filters are limited only by hygiene, and increased breathing resistance. The filter media will not degrade over time. The protocol for QNFT is detailed in Appendix A of the California Code of Regulations, Title 8, Section 5144.

Advantages and Disadvantages of APRs

Advantages of APRs

- Relatively Small and lightweight
- Do not affect mobility
- Easily maintained: disposable or relatively easy to disassemble and clean
- They can protect the lungs from toxic exposures if used properly



Disadvantages of APRs

- Cannot be used in oxygen deficient atmospheres.
- Cartridges are not available for all air contaminants.
- Certain cartridges, canisters or filters inhibit air flow and can make it difficult to breathe.
- Limited capacity of air purifying elements
- Hot and uncomfortable
- Often fit poorly, allowing you to breathe in toxic substances
- Some types do not provide eye protection or prevent skin exposure
- Proper use requires training, regular maintenance, proper storage, and air monitoring

Warning Properties—How Do You Know If Your Respirator Isn't Working?

Any respirator can fail. The smell, taste, or irritation of the contaminant can be a warning that your respirator is not working. But, the question is, will the chemical harm you first? Some gases and vapors have a noticeable smell or taste below the PEL, but others, such as carbon monoxide, give you no warning even as they're killing you. Cal/OSHA prohibits the use of air purifying respirators unless there is adequate warning below the PEL.

Here's an example of how warning properties can be used.

For each chemical, we'll figure out whether you'll have adequate warning if your respirator leaks.

Chemical	Warning Conc. (ppm)	PEL (ppm)	Warning Properties Adequate??
MEK	5.4	200	
MIC	2.1	0.02	
TDI	0.17	0.005	
Methyl formate	600	100	

With some of the above chemicals, you'd have no warning that your respirator failed until the concentrations were far above the PEL. A small number of cartridges and canisters have end-of-service life indicators for use with specific contaminants that have poor warning properties. This is the only circumstance in which you can use an air purifying respirator if the contaminant has poor warning properties.







NOTE: There's a lot of variability in the abilities of each of us to detect odor, so that a gas or vapor will not have equally good warning properties for all respirator users. This is a reason why respirators are a control of last resort.

Protection Factors: Does Your Respirator Offer You Enough Protection?

Each type of respirator is rated for the protection it is assumed to give the average wearer. This is called the Protection Factor (PF) and is a property of the type of respirator itself.

A PF of 10 means that the respirator is supposed to protect you at concentrations of 10 times the PEL. Likewise, a PF of 50 is supposed to protect you at concentrations of 50 times the PEL. The higher the PF of a respirator type, the more protection the respirator provides. The table below shows the PF for several different types of respirators when used against combination gas/vapor and particulate exposures.

Type of Respirator	Protection Factor
Half-mask air purifying respirator	10
Full-face air purifying respirator	50
Self-contained respirator with full facepiece operated in negative pressure mode	50
Powered air purifying respirator	25-50
Supplied air respirator with full facepiece operated in positive pressure mode	2000
Self-contained respirator with full facepiece operated in positive pressure mode	10,000

RESPIRATOR		APF NIOSH	
	Half-Face APR	10	
	Full-Face Cartridge —or— Cannister APR		
	PAPP Tight fitting Full-Face	50	
	Full Facepiece SCBA	Demand	50
		Pressure–Demand	10,000
	Full Facepiece Air-Line Respirator	Demand	50
		Pressure–Demand	2,000
		Pressure–Demand with Escape Bottle	10,000

Types of Supplied Air Respirators

When the concentration of a chemical is either too high or unknown, or when there is less than 19.5% oxygen in the environment, you need to bring in your own fresh air. Supplied Air Respirators provide fresh air to breathe. There are two types of supplied air respirators: the Self-Contained Breathing Apparatus (SCBA) and the airline respirator.

Self-Contained Breathing Apparatus (SCBA)

With an SCBA, you carry a breathing supply of air with you that lasts from 3 minutes to 4 hours, depending on the type of SCBA.

Unlike the airline respirator, the SCBA does not require an escape bottle and can be used **by itself** in IDLH environments.

There are two main types of SCBAs:

1. Open Circuit SCBA:

- A tank of compressed air is carried on the back which supplies air via a regulator to the facepiece.
- Exhaled air is returned (or exhausted) to the atmosphere (this is why it is called “open circuit,” because it is open to the atmosphere).
- This is the only respirator which can be used in IDLH or oxygen deficient atmospheres, but the air supply (depending on size of air cylinder) is limited from about 3 to 45 minutes.
- This is the only respirator that can be used if either the air contaminants or their concentrations are unknown.

Open Circuit SCBA's are available with two types of facepieces: Negative Pressure and Positive Pressure:

Negative Pressure

These are also called “demand” respirators, since fresh air enters the facepiece only when you breathe in (on demand). During inhalation, there is a negative pressure in the mask, so that if leakage occurs, contaminated air will be drawn into the mask.

Positive Pressure

These are called “pressure demand” respirators because they have a continuous flow of air into the respirator at all times regardless of your “demand.” Pressure in the mask is usually positive, so that if leakage occurs, contaminated air will generally not be drawn into the mask.

2. Closed Circuit SCBAs

- Air is “rebreathed” after the exhaled carbon dioxide is removed and the oxygen content restored.
- Designed for 1-4 hours use.
- Since the facepiece is under negative pressure, closed circuit SCBAs should be used in IDLH atmospheres only under special circumstances.

Airline Respirators

- Deliver compressed air from a stationary source through a high pressure hose; you do not carry the air with you.
- Can be equipped with half- or full-face masks, helmets, or hoods, or can come as a complete suit.
- Have facepieces that operate on “pressure demand” or “positive pressure,” so contaminated air cannot be drawn into the mask.
- **Cannot be used by themselves** in IDLH atmospheres because if something happened to the hose or air supply, you could die. If you have a small self-contained supply of respirable air for escape (an “escape bottle”), an airline respirator may be used in IDLH environments.
- Unlike SCBAs, the airline respirator can be continuously used for a long period of time, depending on the amount of air in the supply tanks.

Advantages and Disadvantages of Supplied Air Respirators

Advantages of Supplied Air Respirators:

- They have high protection factors. This allows workers to enter areas with unknown contaminants or with high concentrations of contaminants.
- They provide an independent source of oxygen.

Disadvantages of Supplied Air Respirators:

- The equipment can limit your mobility.
- The equipment is costly.
- The equipment must be regularly and carefully maintained.

Fit-Testing

What is fit-testing?

A respirator is only as good as its ability to create a seal with your face. Fit-testing tests how well your respirator forms a seal with your face to prevent leaks.

Why do fit-testing?

Most respirators are made to fit the average male face. But half of us are not males, and very few of us have average faces. Scars, dentures, high cheekbones, etc., can make it very difficult to get a proper fit with a respirator. Your respirator must fit you properly in order to protect you against dangerous chemicals.

Cal-OSHAA requires that your employer fit-test you when you first receive your respirator to make sure it fits you properly. Your respirator must also be fit-tested every year after that.

Which respirators should be fit-tested?

All respirators, both negative and positive pressure facepieces, must be fit-tested.

Quantitative Fit Tests: Getting an Exact Measurement

A **quantitative fit test** uses a mechanical device to detect a leak in the facepiece.

This is done by:

1. putting the worker whose respirator is being tested inside a booth containing a measured concentration of a chemical;
2. using a probe to continuously measure the concentration of the chemical inside the worker's respirator; or
3. using a probe that measures leakage of air into the mask, and after each exercise, the worker holds his/her breath while the measurement is taken.

For each test method, the worker has to:

- breathe normally,
- breathe deeply,
- move the head side-to-side,
- move the head up and down,
- read out loud either the Rainbow passage or count backwards from 100,
- do toe touches,
- breathe normally again.



Pressure Tests (Daily Field Fit Checks)

These tests can be performed alone by a worker with his/her respirator and no other equipment.

While your employer must do either qualitative or quantitative fit-testing when providing you with a respirator, you must do “field” fit-testing just before you enter a hazardous environment and periodically during the work day. This is the **only** way that you can be sure that the facepiece seal is good.

There are two field fit checks you should do before wearing your respirator:

Negative Pressure Check:



1. Cover the opening of the canister, cartridge(s), and filter(s) with the palms of the hand so that air cannot get through.
2. Inhale gently so that the facepiece collapses slightly.
3. Hold your breath for about 10 seconds.
4. If the facepiece remains slightly collapsed and no leakage is felt, the fit is probably acceptable.



Positive Pressure Check:

1. Cover up the exhalation valve so that no air can get through.
2. Exhale gently into the facepiece.
3. The fit is considered acceptable if slight positive pressure can be built up inside the facepiece without outward leakage.

Advantages and Disadvantages of Qualitative and Quantitative Fit-testing

Advantages of Qualitative Test

- Fast
- No complicated or expensive equipment required
- Can be performed by you

Disadvantages of Qualitative Test

- Relies only on worker's opinion or response (greater margin of error)

Advantages of Quantitative Test

- More accurate
- Does not rely only on a worker's opinion or response (less margin of error)

Disadvantages of Quantitative Test

- Can be more time-consuming
- Requires expensive equipment, operated by trained personnel only
- Each test facepiece must be one which the worker would actually select to use at his/her workplace

Maintenance of Respiratory Protection

In order to keep APRs working properly, follow these steps for maintaining an APR:

1. INSPECTION OF RESPIRATORS FOR DEFECTS

A. Inspection Schedules

All respiratory protective equipment must be inspected:

- **Before** and **after** each use
- During cleaning

Equipment designated for emergency use must be inspected:

- After each use
- At least monthly
- During cleaning

B. Inspection of Air Purifying Respirators

Before putting on your respirator, examine the facepiece for:

- Excessive dirt, dust, etc.
- Cracks, tears, holes or distortion from improper storage
- Cracked or badly scratched lenses in full facepieces
- Incorrectly mounted full facepiece lens or missing mounting clips
- Cracked or broken air-purifying element holder(s), badly worn threads, or missing gasket(s), if required

Examine the head straps or head harness for:

- Breaks

- Loss of elasticity
- Broken or malfunctioning buckles and attachments
- Excessively worn straps which might permit slippage

Examine the exhalation and inhalation valve for:

- Foreign material, such as detergent residue, dust particles, or human hair under the valve seat
- Cracks, tears, or distortion in the valve material
- Improper insertion of the valve body in the facepiece
- Cracks, breaks, or chips in the valve body, especially in the sealing surface
- Missing or defective valve cover (exhalation valve)
- Improper installation of the valve in the valve body

Remove and examine the o-rings, checking for cracks and tears, detergent residue, and deformities.

Examine the air-purifying elements for:

- Correct cartridge, canister, or filter for the specific hazard
- Correct installation, loose connections, missing or worn gaskets, or cross-threading in the holder
- Expired shelf-life date on the cartridge
- Cracks or dents in the outside case of the filter cartridge
- Evidence of prior use of the absorbent cartridge or canister, indicated by the absence of sealing material, foil, tape, etc., over inlet. Check manufacturer's instructions for further information.

2. CLEANING AND SANITIZING

The manufacturer's instructions should be followed for cleaning and sanitizing respirators, especially in regard to maximum temperatures.

Any good detergent may be used, but cleaner and sanitizer solutions that clean effectively and contain a bactericide are available. There is a possibility of dermatitis (a skin condition) if the sanitizing solutions are not completely rinsed from the respirator.

An alternative is to wash the respirators in detergent, followed by a disinfecting rinse. Disinfection is not absolutely necessary if the respirator is reused by the same worker. However, where individual issue is not practiced, disinfection is strongly recommended. Reliable, effective disinfectants may be made from readily available household solutions, including:

- Hypochlorite solution (50 ppm of chlorine) made by adding approximately 2 ml of hypochlorite (laundry) bleach to 1 liter of water. A 2-minute immersion disinfects the respirators.
- aqueous solution of iodine (50 ppm of iodine) made by adding approximately 0.8 ml tincture of iodine per liter of water. The iodine is approximately 7% ammonium and potassium iodide, 45% alcohol, and 48% water. Again, a 2-minute immersion is sufficient.

To avoid damaging the rubber and plastic in the respirator facepieces, the cleaner and disinfectant temperatures should not exceed 110° F.

3. RINSING

The cleaned and disinfected respirators should be rinsed thoroughly in clean water (110° F maximum) to remove all traces of detergent, cleaner and sanitizer, and disinfectant. This is very important to prevent dermatitis.

4. DRYING

The respirators may be allowed to dry by themselves on a clean surface. They also may be hung from a horizontal wire, like drying clothes, but care must be taken not to damage the facepieces.

A better method is to use a commercially available, electrically heated steel storage cabinet with a built-in circulating fan, and replacing the solid shelves with steel mesh, if necessary.

5. REASSEMBLY AND INSPECTION

The clean, dry respirator facepieces should be reassembled and inspected in an area separate from the disassembly area to avoid contamination. Inspect for detergent or soap residue left by inadequate rinsing. This appears most often under the seat of the exhalation valve, and can cause valve leakage or sticking.

At this time, the respirators should be thoroughly inspected and all defects corrected. New or retested filters, or new cartridges and canisters should be installed, and the completely reassembled respirator should be tested for leaks.



6. ADJUSTMENT AND REPAIR

The OSHA Standards state that “repairs or adjustments to respirators are to be made only by persons appropriately trained to perform such operations and shall use only the respirator manufacturer’s NIOSH-approved parts designed for the respirator.” Parts from a different brand or type of respirator should never be substituted.

An important aspect of any maintenance program is having enough spare parts on hand. Pay attention to what parts are used up quickly in order to determine what parts (and how many of them) should be kept in stock. Keep a record of spare parts that are used and how many are on hand.

How To Inspect Your Respirator

STRAPS—hold the respirator on your head. One goes over the crown of your head. Another headband has two plastic straps, which go straight up and straight back on your head.

Check: Are they elastic? Are they torn? Do the buckles and snaps work?

FACE PIECE—is made of rubber, silicon, or other materials.

Check: Is it ripped or worn? Is the face piece bent? Is it clean?

GASKETS—are rubber rings that make a tight seal between the filter and the face piece present. (Not every respirator has gaskets.)

Check: Are they there? Are they ripped or torn?

Filters—filter the air. They are also called “cartridges.”

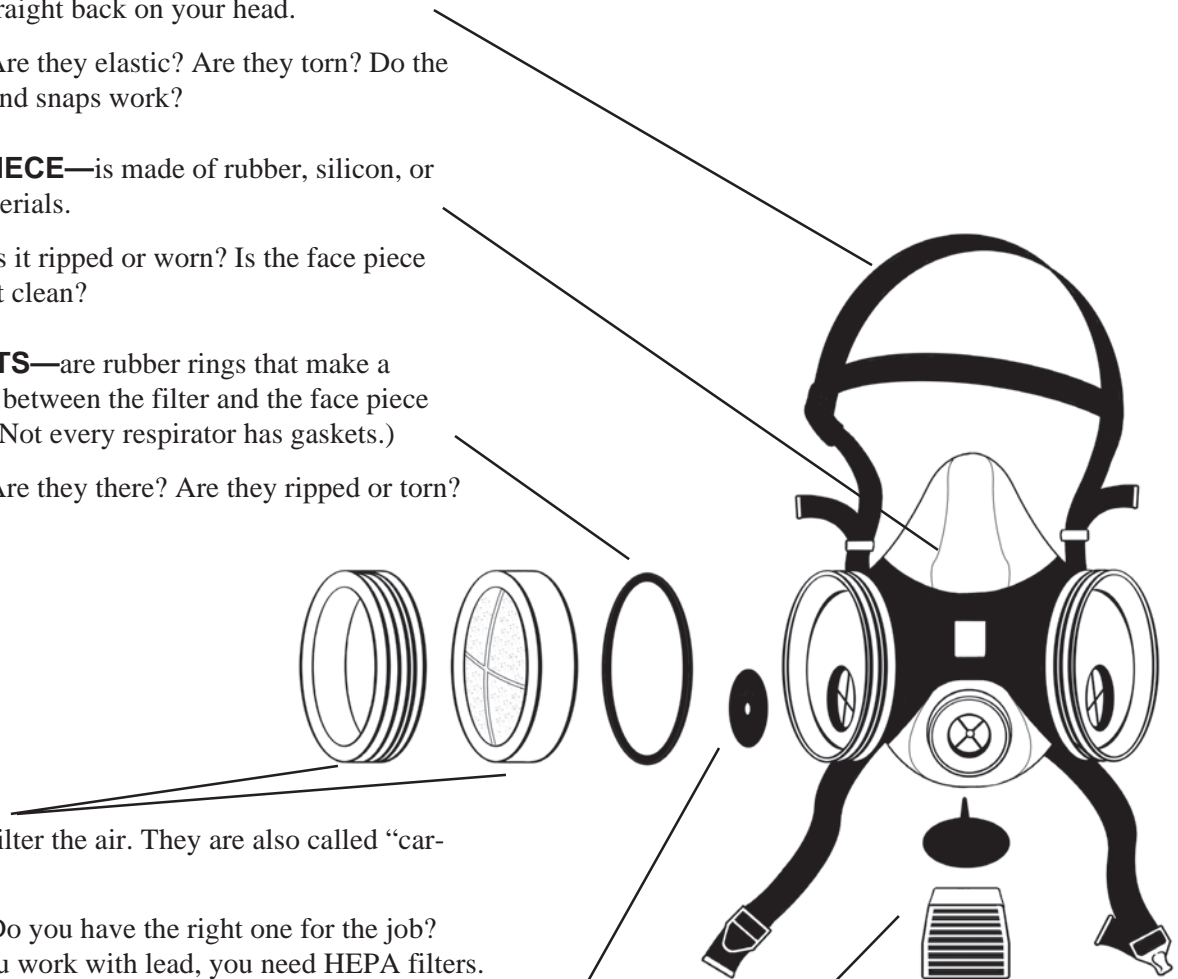
Check: Do you have the right one for the job? When you work with lead, you need HEPA filters. When you use solvents or caustic paste, you will need other filters, too. Change filters regularly, especially when it becomes harder to breathe.

INHALATION VALVES—are where you breathe in. There are two small rubber flaps behind the filters.

Check: Are both there? Are they ripped or bent? Are they dirty?

EXHALATION VALVE—Is where you breathe out. It is a small rubber flap about the size of a quarter. It is underneath a cover.

Check: Take off the cover. Is the valve there? Is it ripped or bent? Is it dirty?



Caring for Your Respirator

In order to protect you, your respirator needs to be cared for properly. This includes:

- Regular inspection;
- Replacement of parts such as valves, filters, etc.;
- Cleaning and sanitizing; and
- Proper storage.

Cleaning

The respirator facepiece should be cleaned and disinfected regularly. Each respirator should be cleaned and sanitized before worn by another individual. They should be air dried after washing. Manufacturer guidelines should be followed when cleaning respirators.

Storage

Respirators should be stored in clean environments with the cartridges removed. They should not be exposed to extreme temperatures or moist environments. The rubber should not be distorted when stored.

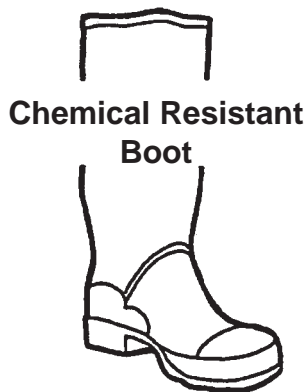


Chemical Protective Clothing

Some Examples of Chemical Protective Clothing



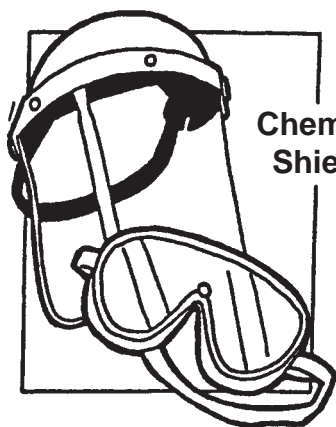
Chemical Resistant
Suit



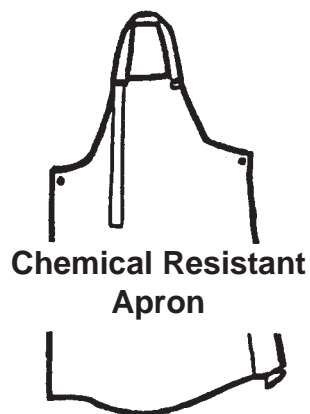
Chemical Resistant
Boot



Chemical Resistant
Gloves



Chemical Resistant
Shield & Goggles



Chemical Resistant
Apron

Outline

1. Chemical Protective Clothing (CPC)
2. Match the Material to the Chemical
3. Four Levels of Protection
4. Select the Correct Glove
5. Heat Stress Problems Associated with Personal Protective Equipment (PPE)
6. Other Safety Hazards of PPE
7. Overview of a Personal Protective Equipment (PPE) Program
8. Wear Your PPE Correctly
9. What Is Decontamination?
10. Work Zones
11. Decontamination Process

Objectives

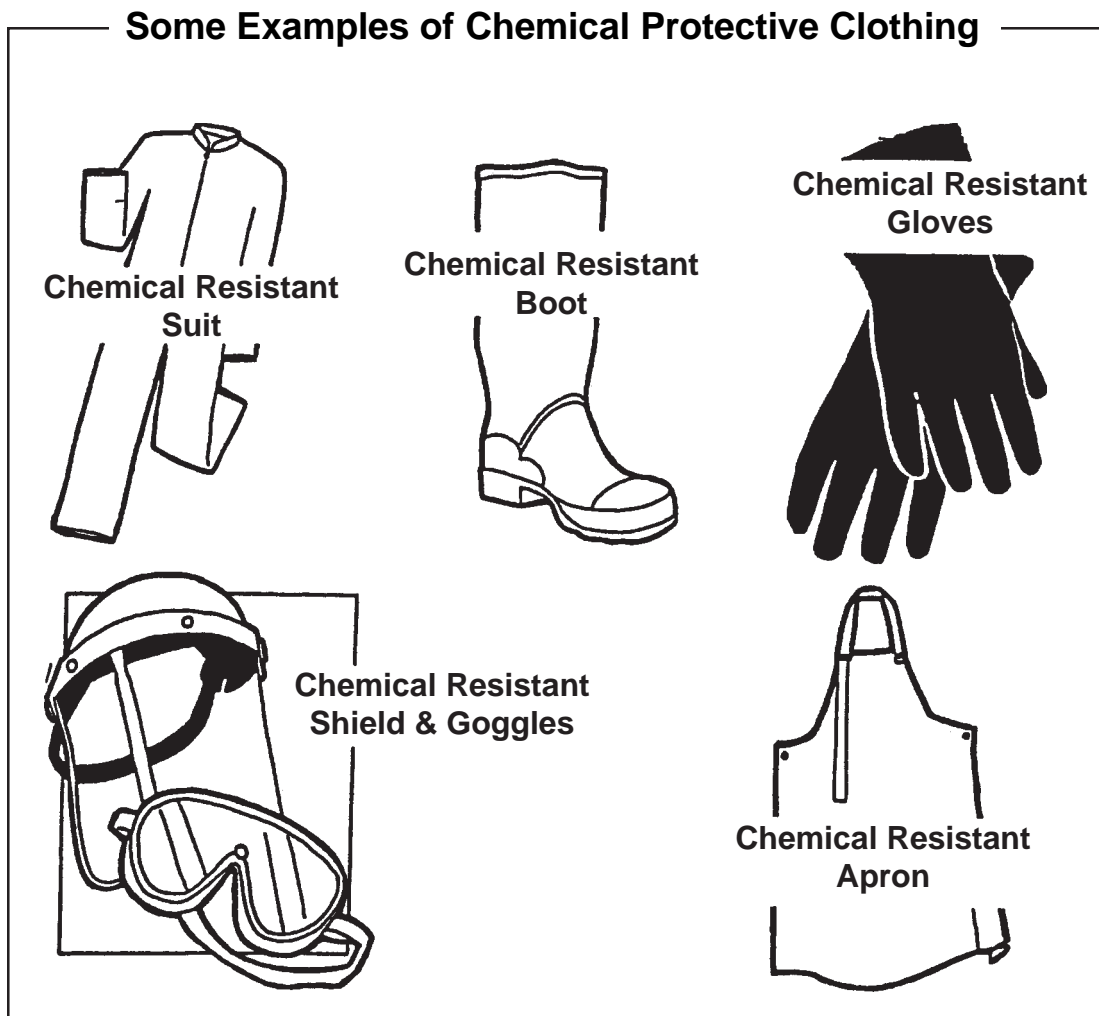
Participants will be able to:

1. List the 4 EPA levels of Protection.
2. Describe how to choose the correct Personal Protective Clothing.
3. Recognize the principles of decontamination.

Chemical Protective Clothing (CPC)

Overview of CPC

Personal Protective Equipment (PPE) includes all protective devices that workers use on the job. These devices include respirators, safety equipment and chemical protective clothing. Safety equipment often includes protective clothing designed to protect against abrasions, heat, water, cold, and falling objects. Generally, this clothing is not designed to protect against hazardous chemicals. Chemical Protective Clothing (CPC) is specifically designed to prevent exposure to these chemicals. CPC may include goggles, a faceshield, an apron, gloves, boots and a suit.



source for next several pages: *Basic Health and Safety Course for Hazardous Waste Site Personnel*, The New England Consortium, 1997.

Selecting CPC

Four- Point Approach When Selecting Chemical Protective Clothing

1. Identify the Chemical Hazard
2. Evaluate Chemical Exposure
3. Evaluate Chemical Resistance of CPC
4. Evaluate Physical Resistance of CPC

1. Identify the Chemical Hazards

Back to the AREC model. We've talked about RECOGNITION of HAZARDS. You've learned how to:

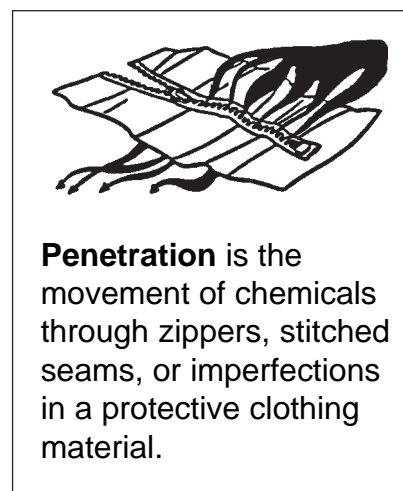
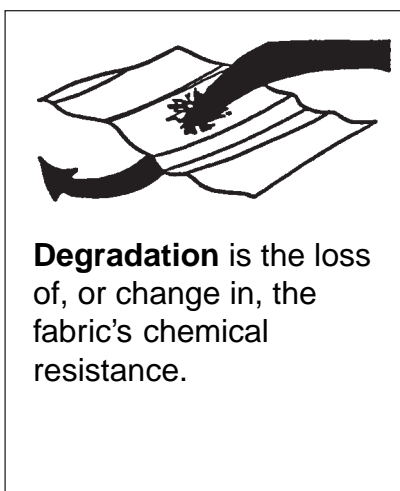
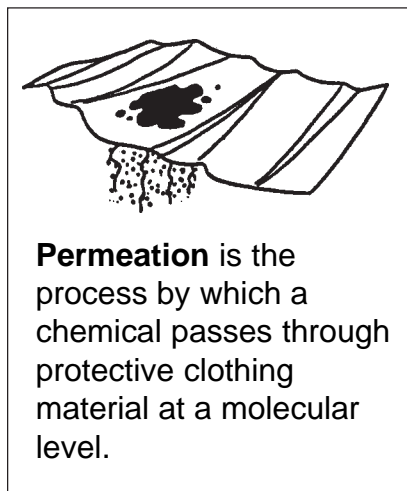
- Identify the chemical or chemical family;
- Identify the physical form of the threat: vapor, liquid, solid;
- Identify the harmful action upon the body: e.g., an irritant to the lungs, a corrosive to the skin, toxic to the body, or a known or suspected carcinogen;

2. Evaluate the Chemical Exposure

- Evaluate the extent of hazard by looking at the IDLH, TLV, or PEL.
- Evaluate the extent or level of your potential exposure for the job. (This is hard to do.) It is important to get a sense of how great a risk you face. This helps in deciding what level and type of CPC to use, as well as how to decontaminate after the exposure.

3. Evaluating Chemical Resistance of CPC

CPC must be matched to the chemical you are exposed to. No material protects against all chemicals, and no material is completely impermeable. Chemicals can get through materials in three ways; permeation, degradation, and penetration.



Chemical resistance is the ability of the clothing or material to prevent or reduce exposure to chemicals. All materials are subject to some degree of degradation or permeation and penetration. The time it takes a chemical to permeate a material is called the breakthrough time. Breakthrough may be immediate or take more than 24 hours. The actual breakthrough time depends on the suit material and the chemicals involved. You want material which has a breakthrough time greater than your exposure time. Permeation data should be provided by the manufacturer. (Examples of permeation tables are on pp 18 & 19.) **There is no such thing as a completely impermeable suit.**

One means of increasing protection is by layering suits. Many suits today are made of several thin layers of different materials. This strategy allows for lightweight suits with good permeation characteristics for a wide range of chemicals.

Performance Testing

At this time, manufacturers are not legally required to conduct specific performance tests on CPC. However, the National Fire Protection Association (NFPA) has published three performance standards for CPC:

- NFPA 1991: Vapor-Protective Suits for Hazardous Chemical Emergencies

- NFPA 1992: Splash-Protective Suits for Hazardous Chemical Emergencies
- NFPA 1993: Support Function Protective Clothing for Hazardous Chemical Operations.

These standards define the conditions, which require vapor, splash, or support function protective clothing. They also list minimum performance tests and test methods for each category of CPC. Most of these tests were developed by the American Society for Testing and Materials (ASTM). In Appendix B of HAZWOPER, OSHA recommends that selected CPC meet the requirements of these NFPA standards.

You should not assume that manufacturers are performing the correct tests. Some manufacturers may be performing limited testing or using faulty methods. When selecting CPC, you want to know the test results and how the tests were performed. You can then compare this information with NFPA standards. Manufacturers should be eager to supply you with this information. If they are not, beware!

Manufacturing Inconsistencies

Different manufacturers may produce the same types of materials, such as butyl rubber, neoprene and latex. Don't assume that these materials will perform the same. Look at the performance data for the specific product you intend to use.

4. Evaluate the Physical Characteristics of CPC

A piece of CPC is of little value if it easily rips or tears. It is also of limited value if things like folding the material or leaving it in hot environments reduces its chemical resistance. To prevent these problems, the following important performance tests have been developed to evaluate physical characteristics.

- abrasion resistance
- heat resistance
- ozone resistance
- cut resistance
- puncture resistance
- burst strength
- flexibility
- tear resistance

Physical Characteristics of Some CPC Materials*

Material	Abrasion Resistance	Cut Resistance	Flexibility	Heat Resistance	Ozone Resistance	Puncture Resistance	Tear Resistance
Butyl Rubber (Butyl)	F	G	G	E	E	G	G
Natural Rubber (Nat. Rub.)	E	E	E	F	P	E	E
Neoprene (Neop.)	E	E	G	G	E	G	G
Neoprene/Styrene-Butadiene Rubber (Neop./SBR)	G	G	G	G	G	G	G
Neoprene/Natural Rubber (Neop./Nat. Rub.)	E	E	E	G	G	G	G
Nitrile Rubber (Nitrile)	E	E	E	G	F	E	G
Nitrile Rubber/Polyvinyl Chloride (Nitrile/PVC)	G	G	G	F	E	G	G
Polyethylene (PE)	F	F	G	F	F	P	F
Chlorinated Polyethylene (CPE)	E	G	G	G	E	G	G
Polyurethane (PU)	E	G	E	G	G	G	G
Polyvinyl Alcohol (PVA)	F	F	P	G	E	F	G
Polyvinyl Chloride (PVC)	G	P	G	P	E	G	G
Styrene-butadiene Rubber (SBR)	E	G	G	G	F	F	F
Viton	G	G	F	G	E	G	G

* Ratings are subject to variation depending on formulation, thickness, and whether the material is supported by fabric. **E = Excellent; G = Good; F = Fair; P = Poor**

Source: Martin, W. F., Lippitt, J. M., Prothero, T. G. (1987). *Hazardous Waste Handbook for Safety and Health*, Butterworths, Boston.

Match the Material to the Chemical

Permeation Data for Chemical Protective Clothing

Limited-use clothing is priced for convenient disposal when decontamination and reuse isn't practical. Compared to materials such as viton, neoprene, butyl and hypalon, limited-use materials are lighter in weight and withstand a broader range of chemicals. These materials are now very common in the fields of hazardous waste operations and emergency response.

Table 1—**Limited-Use Clothing Permeation Data** (page 18) gives manufacturers' permeation test results (ASTM 739) for some limited-use materials.

Table 2—**Glove Permeation Data** (page 19) gives the same information for some chemical protective gloves.

These tables include only a small selection of the chemicals that you might be exposed to on the job. A more complete record of test results can usually be obtained directly from the manufacturer.

The information in these tables does not attempt to address all the safety issues associated with chemical protective clothing. Differences in material strength and garment construction, and environmental and physical conditions can effect the degree of protection. All these factors should be considered when selecting chemical protective clothing.

Guide to the Tables

The first number given is the breakthrough time, in minutes.

The second number, in parentheses, is the steady-state permeation rate, in micrograms per square centimeter per minute.

nd = not detected

nt = not tested

ID = insufficient data

NR = not recommended

T = good for total immersion

I = good for intermittent contact

CHEMICAL PROTECTIVE CLOTHING GUIDE

MATERIAL	GOOD FOR	POOR FOR	COST
Butyl Rubber (Synthetic Rubber)	bases & many organics; heat & resistance; decontamination	halogenated hydrocarbons; gasoline; aliphatic & aromatic hydrocarbons; abrasion resistance	gloves - \$10/pair boots - \$25/pair fully encapsulating suit (FES) - \$900-\$1350
Chlorinated Polyethylene (Chloropel, CPE)	acids & bases; abrasion; aliphatic hydrocarbons; alcohols; phenols; longer shelf life (resists ozone); used in splash suits and FES	amines; esters; ketones; halogenated hydrocarbons; cold temperatures	splash suit - \$60 FES - \$60
Natural Rubber	alcohol; flexibility; dilute acids & bases	organic chemicals; aging	gloves - \$10-\$15/doz boot covers - \$5/pair
Neoprene (Synthetic Rubber)	bases & dilute acids; peroxides; fuels & oils; aliphatic hydrocarbons; alcohols; glycols; phenols; abrasions & cut resistance	halogenated hydrocarbons; ketones; aromatic hydrocarbons; concentrated acids	gloves - \$13-\$70/doz splash suit - \$40-\$60 boots - \$35/pair
Nitrile	petroleum compounds; PCBs; phenols; oils & fuels; alcohols; amines; bases; peroxides; abrasion & cut resistance; flexibility (decreases as increase chemical resistance with addition of nitrile)	aromatic & halogenated hydrocarbons; amides; ketones; esters; cold temperatures	gloves - \$25/pair boots - \$18/pair
Polyurethane	bases; abrasion resistance; aliphatic hydrocarbons; alcohols; flexibility at cold temperature	halogenated hydrocarbons	boots - \$25/pair splash suit - \$60
Polyvinyl Alcohol (PVA)	acids & caustics; almost all organics	water; water solutions; esters; ethers; flexibility	gloves - \$13/pair
Polyvinyl Chloride (PVC)	acids & bases; peroxides; some organic amines	most organics; cut & heat resistance; decontamination	gloves - \$17-\$25/doz boots - \$15/pair splash suit - \$10-\$30 FES - \$300- \$900
Viton (Plastic Fluoroelastomer similar to Teflon)	aliphatic & aromatic hydrocarbons; halogenated hydrocabons; deontamination oxidizers; acids	ketones; esters; aldehydes; amines	gloves - \$27/pair FES - \$1600 - \$3000
Teflon (similar to Viton)			suits - \$2000 - \$3000
Tyvek (spun bound non-woven Polyethylene fibers)	particulates & dust; tear, puncture & abrasion resistance	chemical resistance; durability	suit - \$3 - \$5
Polyethylene Coated Tyvek	preventing gross contamination of non-disposables; low concentrations of liquids & vapors; PCBs; decontamination (disposal); low splash situations	halogenated hydrocarbons; aromatic hydrocarbons; penetration; (stitched seams)	suit - \$8 - \$15 gloves - \$2/box of 100 booties - \$13/box of 50
Saranex	acids & bases; amines; some organics; PCBs	halogenated hydrocarbons; aromatics; penetration; (stitched seams)	suit - \$15
Nomex (Polyamide fiber)	thermal protection up to 220°C; acid resistant; shelf life; fire fighters turn-out gear	chemical protection	expensive

Four Levels of Protection

Personnel must wear protective equipment when activities involve known or suspected chemical, physical, or biological hazards.

Equipment ensembles that protect the body against contact with known or anticipated toxic and hazardous chemicals have been divided into four categories according to the degree of protection afforded:

- LEVEL A Should be worn where the highest level of respiratory, skin and eye protection is needed.
- LEVEL B Should be worn where the highest level of respiratory protection, but a lesser degree of skin protection is needed.
- LEVEL C Should be worn when the criteria for air-purifying respirators are met, and some skin protection is needed.
- LEVEL D Should be worn as a basic work uniform where there are no skin or respiratory hazards. It provides no respiratory protection and minimal skin protection.

In hazardous waste operations, levels of protection will be based on the measure of atmospheric concentration of the chemical substance and its toxicity. Other considerations include potential exposure to splashes of liquid, or other direct contact with material due to the work being done.

As additional data become available, a decision to move up or down a level may be made. This decision to upgrade or downgrade levels of protection must be made by a qualified person. In general, it is best to start with a higher level of protection and downgrade as better information dictates.

Level A Protection

Description—Level A provides the maximum level of protective clothing and respiratory protection. It is designed to prevent contact of skin and body parts with hazardous vapors, liquids and solids

Conditions that Warrant Level A include:

- High potential for splash or immersion, or potential exposure to gases or vapors that can be absorbed through the skin;
- Potential exposure to unknown vapors, gases, particulates;
- Direct skin and eye contact;
- Potential for exposures above IDLH;
- Effects of substance on skin are unknown.

Level A is often necessary for work when little is known about the nature or amount of hazardous material.

Personal Protective Components of Level A

- Light, cotton clothing under CPC
- Positive pressure SCBA
- Hard hat
- Fully Encapsulating Suit (including boots and gloves)
- Gloves:
 - Inner glove
 - Chemical-resistant glove attached to suit
 - Chemical-resistant outer glove*
- Chemical-resistant boots with steel toe and shank (over or under fully encapsulated suit, depending on suit type and construction)
- Disposable boot covers*
- Disposable Tyvek outer suit*

* optional



Level B Protection

Description—Protective clothing worn with maximum respiratory protection. It is designed to minimize or prevent contact of skin and body parts with hazardous substances. It will not prevent skin absorption of gases or vapors, or from extensive contact.

Conditions that Warrant Level B include:

- Limited direct skin and eye contact with hazardous compounds or air contaminants which will not result in severe damage or irreversible effects;
- Work function involving the potential for only minor splashes, and excluding total body splashes or immersion, and;
- Potential exposure to IDLH or oxygen-deficient atmospheres.

Level B is Used for Initial Entry (Contaminants Unknown)

- Use Level B when off-site investigations and observations do not indicate highly toxic compounds.
- Downgrade or upgrade as contaminants are identified.
- Limit activity in the hot zone.

Personal Protective Components of Level B

- Light cotton clothing under protective clothing
- Chemical splash suit
- Positive pressure SCBA
- Hard hat
- Gloves:
 - Inner glove
 - Chemical-resistant outer glove
- Boots, chemical-resistant, steel toe and shank
- Disposable boot covers*
- Chemical-resistant apron*
- Face shield*
- Disposable Tyvek outer suit*



* optional

Level C Protection

Description—This is the same protective clothing as Level B, worn with air purifying respirators. It is designed to minimize contact with many hazardous substances.

Conditions that Warrant Level C include:

- Limited direct skin and eye contact with hazardous compounds or air contaminants that will not result in severe damage or irreversible effects;
- Work function involves potential for only minor splashes and excludes total body splashes or immersion;
- Conditions appropriate for air-purifying respirator (see Chapter 6).

Personal Protective Components of Level C

- Light, cotton clothing under protective clothing
- Chemical splash suit
- Air-purifying respirator
- Hard hat
- Gloves:
 - Inner glove
 - Chemical-resistant outer glove
- Boots, chemical-resistant, steel toe and shank
- Disposable boot covers*
- Chemical-resistant apron*
- Face shield and or splash goggles (if respirator has half-facepiece)*

* optional



Level D Protection

Description—This is the minimum level of work clothing on a construction site. It is designed to protect workers from common workplace safety hazards.

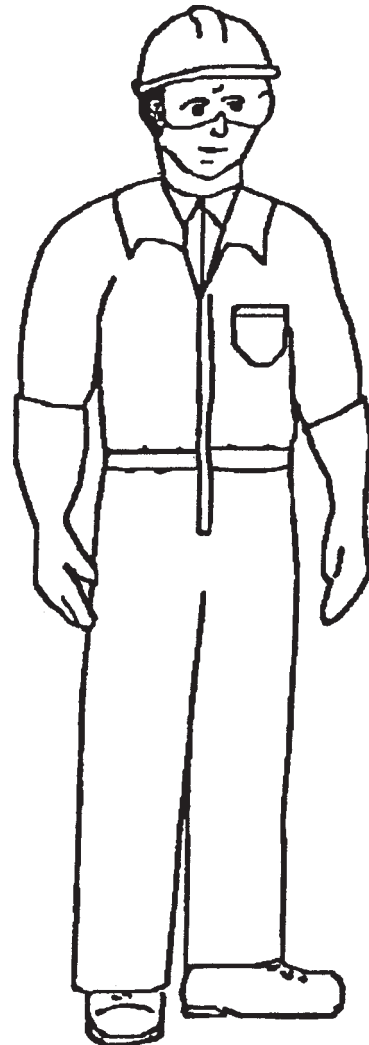
Conditions that Warrant Level D include:

- The compounds of concern do not have adverse skin and eye effects;
- No hazardous air pollutants measured or anticipated to be above the PEL;
- Job tasks preclude splashes, immersion, or potential for unknown respiratory hazards.

Personal Protective Components of Level D

- Work clothes
- Boots/shoes, leather or chemical-resistant, steel toe and shank
- Hard hat
- Splash glasses or goggles
- Face shield*
- Gloves (chemical-resistant or cloth)*
- Disposable coveralls*
- Disposable boot covers*
- Escape mask (air-supplied)*

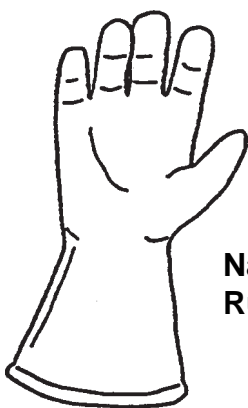
* optional



Selecting the Correct Glove

It is very important that you use the type of glove that is appropriate for the job you are doing and the chemical you are working with. The following list gives examples of the appropriate glove to use for various chemicals:

Chemical	Best Glove	Second Best Glove	Do Not Use
1. Gasoline or combustible "diesel"	Nitrile Rubber Viton	"Silver Shield" Neoprene PVC	Natural Rubber
2. Hydrochloric Acid (37%)	Nitrile Rubber Neoprene PVC	"Silver Shield" Natural Rubber	None
3. Methyl Ethyl Ketone (MEK)	None (the chemical can pass through all)	"Silver Shield" Natural Rubber PVA	PVC Nitrile Rubber Neoprene
4. Methylene Chloride	None	"Silver Shield" Viton PVA	Natural Rubber Nitrile Rubber Neoprene PVC
5. Sodium Hydroxide (50%)	Natural Rubber Nitrile Rubber Neoprene	"Silver Shield" PVC	None
6. Sulfuric Acid (47%)	Nitrile Rubber Neoprene Natural Rubber	"Silver Shield" PVC	None



Natural Rubber



"Silver Shield"



Nitrile

Heat Stress Problems Associated with PPE

The human body keeps a constant internal temperature of about 98.6 degrees F. When we work in very hot areas, our bodies automatically get rid of excess heat by:

- sweating (perspiration)
- increasing blood circulation
- increasing the blood flow to the skin
- radiating heat off the body.

When the body cannot get rid of heat quickly enough, various forms of heat illness may develop. These include heat exhaustion and heat stroke. Heat stroke can cause death.

Using PPE adds weight and bulk and reduces your ability to cool yourself. Wearing PPE increases the risk of developing heat illnesses, including heat stroke.

Factors which contribute to heat illness when using PPE include:

1. Personal Factors, such as:

- weak physical condition
- lack of experience wearing PPE
- dehydration
- overweight or underweight
- alcohol or drug use
- chronic disease
- medication
- infection

2. Environmental Factors, such as:

- high humidity
- direct sunlight or other heat source

3. Working Conditions, such as:

- long work days
- infrequent rest breaks
- no access to drinking water

To prevent heat illnesses (especially when using PPE), it is very important to take frequent breaks and drink plenty of liquids to replace lost fluids!

Heat Illnesses

There are four types of heat illnesses. Each has different symptoms and treatments.

1. Heat Cramps

Symptoms:

- Cramping of legs and abdominal muscles
- Heavy sweating and water loss
- Occurs due to strenuous activity in a warm environment

Treatment:

- Rest in cool shady place
- Light stretching and massage
- Drink liquids to replace water loss

2. Heat Rash

Symptoms:

- Skin remains wet (especially in hot, humid environments)
- Sweat ducts become plugged
- Rash develops

Treatment:

- Rest in cool area
- Dry your skin regularly

3. Heat Exhaustion (Rarely Fatal)

Symptoms:

- Pale, clammy skin
- Heavy sweating
- Large pupils
- Rapid, shallow breathing
- Weakness, dizziness, headache
- Nausea, vomiting

Treatment:

- Go to cool place
- Remove PPE
- Treat for shock
- Give fluids if conscious
- Rest

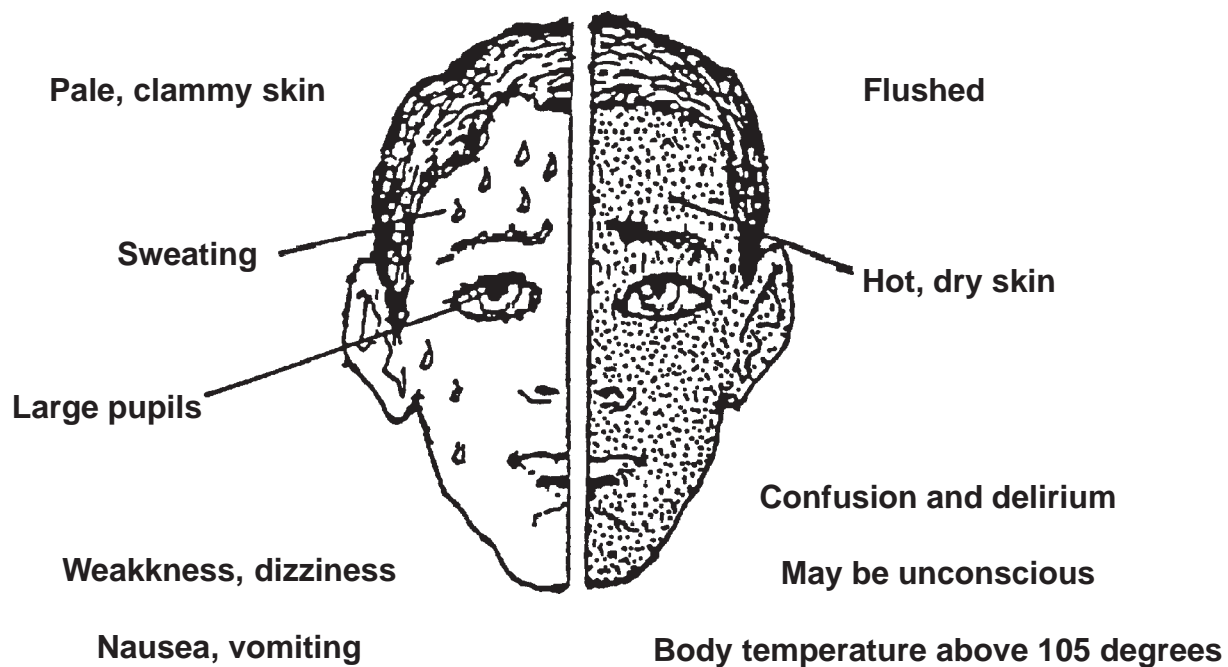
4. Heat Stroke (Can be Fatal)

Symptoms:

- Red (flushed)
- Very hot and dry skin, no perspiration
- Confusion and delirium
- May become unconscious
- Body temperature is 105 degrees or higher

Treatment:

- Go to cool place
- Remove PPE
- Treat for shock
- Cool with ice, cold water, fan
- Get medical help as soon as possible. This is a medical emergency



Heat Stress

Precautions and Control Measures

Heat stress may be reduced by:

1. Engineering

Engineering methods such as ventilation, spot cooling, fans and heat shields, can reduce excessive heat stress or isolate the worker from it.

2. Protective Clothing

Special reflective clothing or cooled suits may be necessary where the heat stress is extremely high.

3. Scheduling and Rest Breaks

Some jobs may be rescheduled to be done during the cool parts of the day, or they may be rescheduled to provide rest periods which allow the body to get rid of some of its heat.

4. Water

Because the thirst mechanism may not adequately stimulated by loss of fluid in the sweat, it is important that a supply of cool water is available and workers drink about 1 cup every half hour.

5. Education

Workers should be taught to recognize the symptoms of heat illnesses and the appropriate first aid measures. They should also know why heat illnesses occur and what can be done to prevent them.

6. Acclimatization

This is the process by which the body gradually adjusts itself to deal with heat. Acclimatization results in lower body temperature at work and rest, higher rate and volume of sweat, slower heart rate and lower oxygen consumption. Because acclimatization is lost very rapidly, workers must be re-acclimatized if away from work for a week or more.

Other Safety Hazards of PPE

There are other stress factors when wearing CPC.

These include:

- Restricted communication;
- Restricted visibility;
- Limited agility and dexterity;
- Psychological effects (claustrophobia and isolation).

These factors combine to increase the likelihood of accidents due to slips, trips, falls and other basic safety hazards. Consider these limitations when developing job descriptions for people working in CPC.

These problems are accentuated when CPC does not fit. Oversized or undersized CPC creates a very serious safety hazard. A selection of different sizes should be available for all types of CPC. If it doesn't fit don't wear it!

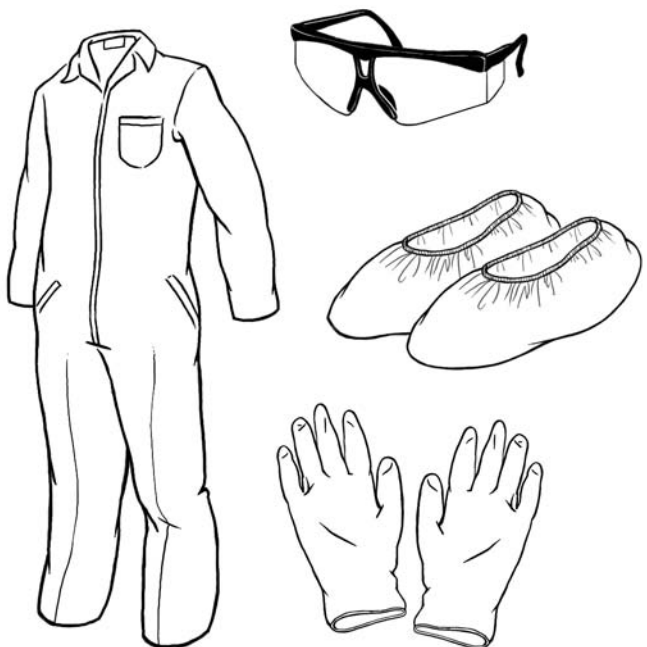
The limited availability of personal protective equipment (PPE) in sizes for women is a critical workplace health and safety issue. It undermines efforts to protect worker health and safety, and presents a barrier to equality of employment opportunity for women.

People working in CPC should always work with a buddy!

Overview of a Personal Protective Equipment (PPE) Program

Written standard operating procedures for the use of PPE must be established as part of the site safety and health plan for work on all hazardous waste sites. This written program should include procedures for:

- Training in wearing PPE;
- Explaining the use and limitations of PPE;
- Selection of PPE according to hazards;
- Work duration while in PPE;
- Donning and doffing procedures;
- Decontamination and disposal procedures;
- Inspection prior to, during, and after use;
- Evaluation of the effectiveness of the PPE program; and
- Medical considerations such as heat stress.



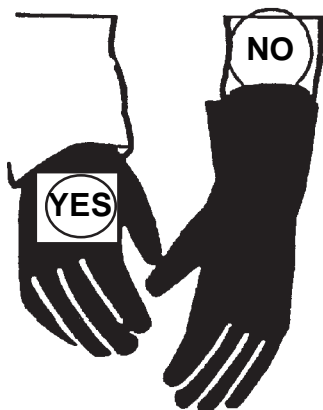
Wear Your PPE Correctly

Selecting the appropriate CPC does not insure adequate protection. CPC must be inspected before each use to insure that it will function as designed. Chemically protective suits should be inspected for defective or damaged seams and zippers. The suit material should be inspected to insure that it was not damaged in storage or during shipment. A garment should not be worn if it has any rips or tears, discoloration, cracking or blistering of protective layers. Imperfections in gloves and outer boots (chicken boots) can be detected by trapping air inside to determine if there are leaks. Vapor-protective suits should be pressure tested according to the manufacturer's recommendations. If the CPC has a shelf life, make sure it has not gone beyond it.

Wear It Right! Make sure that you wear your CPC correctly. You should also make sure that all the components of your ensemble are compatible and they fit properly.

Duct Tape

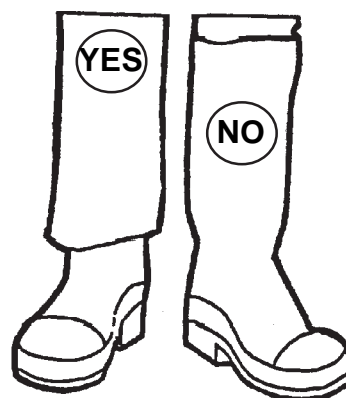
Many workers tape the openings in splash suits, including the collar, sleeves, waist, and pant cuffs, as well as openings between gloves and boots and their suit. You should not assume that tape offers any chemical protection. At best, taping may slow down entry of toxins into the suit by holding the two parts of the suit together.



Wear suit over gloves*



Tape joints to prevent separations

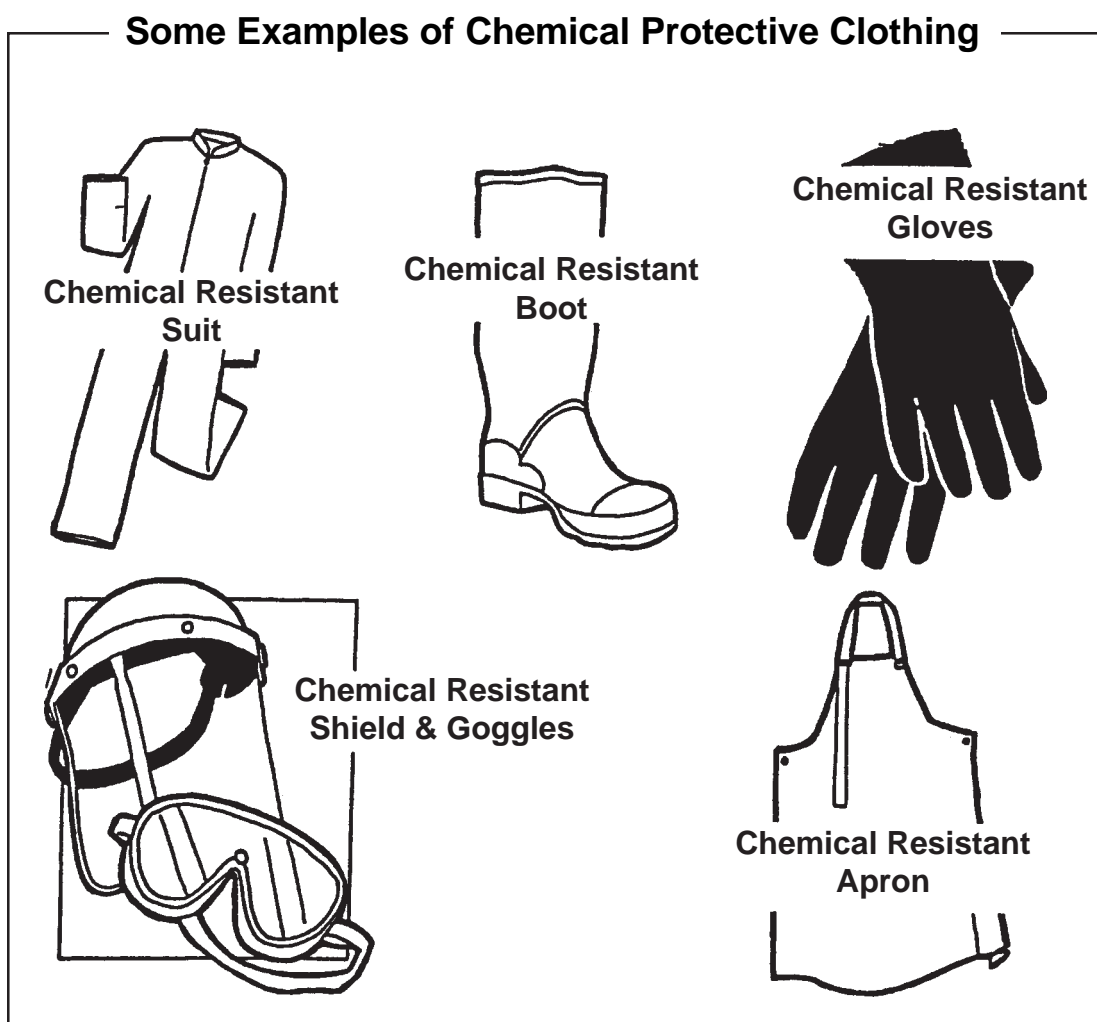


Wear suit over boots whenever possible

* When working overhead you may want an extra outer glove worn outside the suit.

Remember!

- CPC performs differently for different chemicals.
- Consider permeation data for all CPC materials and for all chemicals.
- Consider the overall performance of CPC. Poorly designed seams and zippers may allow significant exposures even if the material resists permeation. CPC that easily rips or tears may be of limited value.
- Avoid exposure if possible even when wearing CPC. No CPC provides absolute protection.
- **MAKE SURE IT FITS!** Poorly fitted CPC is a safety hazard.
- Match the CPC to the job. Too much or too little CPC may put you at risk.



What Is Decontamination?

Decontamination means removing hazardous chemicals from your:

- body
- clothing
- equipment (like your respirator or tools).

There are two ways to decontaminate:

- **Physically remove** the hazardous chemicals (the “contaminants”) by washing, rinsing, and scrubbing.
- **Neutralize** the contaminants by using other chemicals to inactivate them.

Of course, it’s best to **prevent** contamination in the first place. Then there is no need to decontaminate.

Preventing Contamination

When you are cleaning up a chemical spill, or whenever there’s a chance that you could be contaminated by chemicals:

- **Avoid contact with toxic chemicals.** Don’t taste, touch, or sniff chemicals. Don’t walk through areas that you know are contaminated.
- **Use disposable protective clothing and equipment.**
- **Avoid sharp objects** that could tear your protective clothing.
- **Use remote equipment** such as drum grapplers to move and open drums. Don’t handle things unless you have to.
- **Protect instruments and tools from contamination.** Tools can be painted with a coating that peels off later. Keep your equipment bagged. (Measuring instruments in bags may have to be vented to work properly.)
- **Watch for signs that your personal protective equipment (PPE) isn’t working.** Gloves and protective clothing can tear. The material also can weaken (break down) and allow chemicals to get through. If your skin begins to itch or burn, your PPE isn’t working. Pay attention to your body.

- **Always work with a buddy.** Check your buddy's PPE for rips, tears, swelling, and other problems.
- **Act fast.** If you get contaminated or think your PPE has failed, leave the area quickly and get decontaminated.

Remember, PPE can help prevent contamination for a while, but that doesn't mean you can take unnecessary risks.

Decontaminate or Discard?

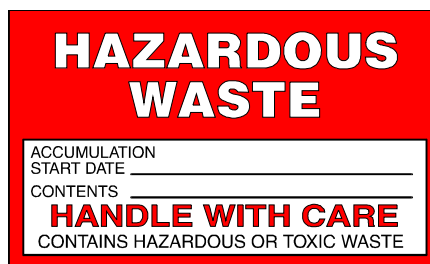
Until recently, most chemical protective clothing (CPC) was rinsed, washed, and then used again. This old practice is starting to change because of two problems:

1. Rinsing and washing create contaminated waste water.
2. There is no way to know if washed clothing is really decontaminated and safe.

In the last few years, disposable chemical protective clothing has become available. It might eventually do away with the need for washing and rinsing.

Disposable CPC (sometimes called "single use" CPC) is worn only once. After use, it is carefully removed and put directly into a labeled drum. The drum can then be disposed of as hazardous waste, following EPA rules.

Using disposable CPC means that contaminated waste water can be kept to a minimum. This saves money and helps the environment.

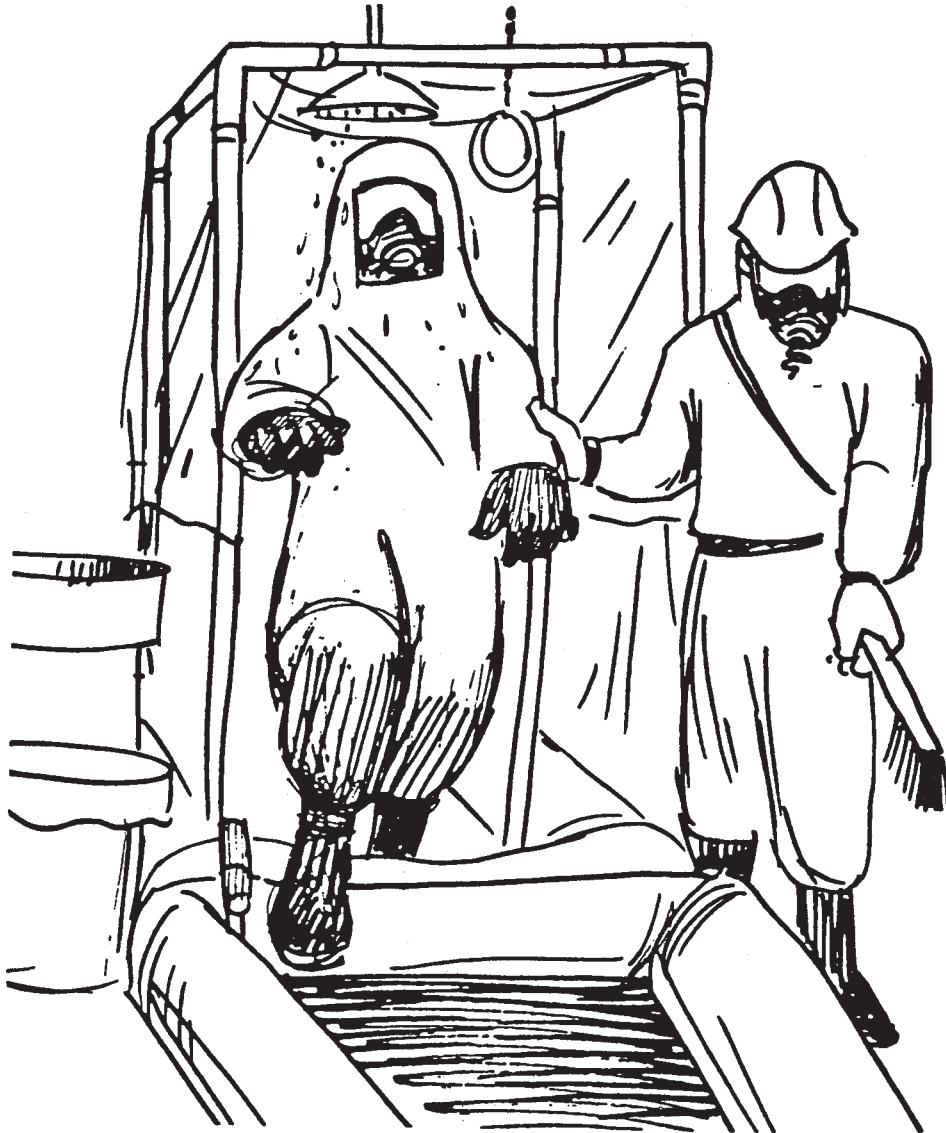


Methods of Decontamination

Decontamination workers are people who are specially trained to remove chemicals from other workers' bodies, clothing, and equipment.

Personal protective equipment (PPE) and chemical protective clothing (CPC) are often decontaminated by scrubbing with a detergent and water mixture. Then they are rinsed with lots of water. (There is also disposable CPC which doesn't need decontamination. See the box, "Decontaminate or Discard?")

Although scrubbing is the most common method of decontaminating PPE and CPC, it may not be effective with certain chemicals.



To choose the right decontamination procedure you must know which specific chemical is involved. If you don't know what it is, you can't neutralize it. The right procedure also will depend upon how much chemical contamination there is, and what protective gear you are using when the contamination occurs.

What to Decontaminate? How to Decontaminate?

To decide what to decontaminate, and how, you need to ask these questions:

- **Which chemical is involved?**

Different chemicals call for different methods of decontamination. You neutralize an acid in a different way than you neutralize a base. Also, the more harmful the chemical, the more thorough the decontamination needs to be.

- **How much of the chemical is present?**

The more chemical there is, the more likely it is that the chemical has gone into or through your chemical protective clothing (CPC) or your personal protective equipment (PPE). There's an increased chance that your CPC, your PPE, or your body could be contaminated.

If you can see the chemical on your skin, clothing, or equipment, you need thorough decontamination. Chemicals are often invisible, so you may not be able to tell how much there is by sight.

And even very small amounts of certain chemicals can be harmful. For example, small amounts of some corrosives can severely burn the skin. When you decontaminate, you don't want to leave even tiny amounts behind.

- **What type of protection are you using?**

If you don't use the right protective clothing and equipment, you need more thorough decontamination. For example, if you use a Self-Contained Breathing Apparatus (SCBA) around chemicals, it's straps and backpack may need to be decontaminated if you didn't wear a protective suit over the SCBA. (Where possible, you should always use a disposable suit that fully encapsulates your body.)

Decontamination Equipment

Disposable protective gear should be used whenever possible. Decontamination requires the supplies and equipment shown here.

**PROTECTIVE CLOTHING MAY BE CONTAMINATED
EVEN IF IT LOOKS OK!**

Make sure these items are always on hand:

- **Throw-away towels** for rinsing and wiping.
- **Plastic drop cloths or lined plastic garbage cans** to hold contaminated clothing and equipment.
- **Long-handled, soft-bristled brushes** for scrubbing.
- **Wash and rinse solutions**—usually detergent and water.
- **Collapsible wading pools** to prevent runoff.
- **Metal or plastic containers** to hold contaminated solutions after use.
- **Shower facilities.**
- **Soap (or wash solutions) and towels** for the showers.



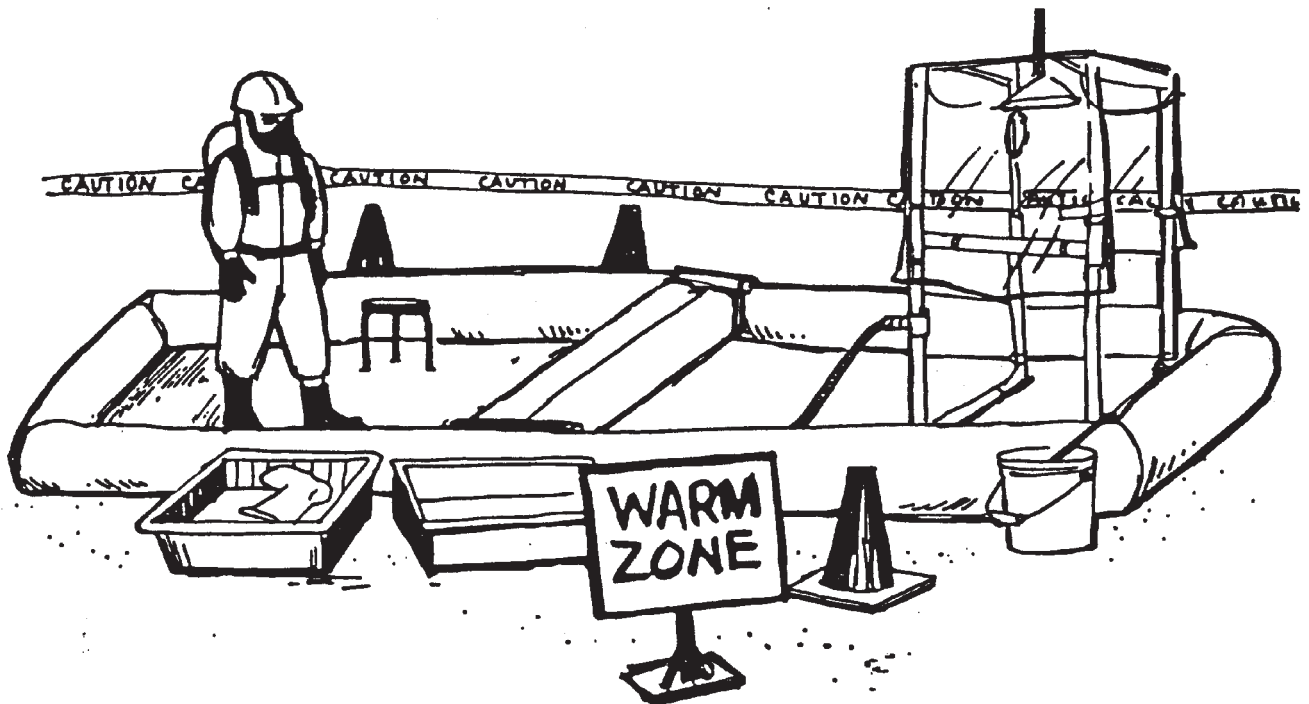
Work Zones

When you deal with a major chemical spill or emergency, set up “work zones” so workers don’t accidentally carry chemicals away from the spill to other areas.

There usually should be three work zones:

- *Hot Zone*—the contaminated zone.
- *Warm Zone*—a buffer between the hot zone and the clean area. Decontamination takes place in the warm zone.
- *Cold Zone*—the clean area.

The three zones should be clearly marked.



At a Chemical Emergency ... Set Up 3 Work Zones

Hot Zone——

This is where the contamination is. Everyone entering the hot zone must wear the proper protection for the chemical involved. Keep the number of people allowed in the hot zone to a minimum. People should always enter the zone in pairs.

The dividing line between the hot zone and the warm zone is called the **hotline**. It's not always easy to decide where the hotline should be. Measuring chemical levels is very important in deciding where to locate the hotline. Other factors to consider include the layout of the area and wind direction. The goal is to set up the hotline at a "safe distance" from the spill so people outside the line won't get hurt.

Warm Zone——

This is the area between the contaminated zone (the hot zone) and the clean area. It's like a buffer zone. The warm zone puts distance between the spill and the clean area, and provides a safe place for decontamination.

Decontamination stations should be set up within the warm zone. At these stations, workers leaving the hot zone remove their protective clothing and equipment. All items are cleaned and/or disposed of properly. The number of decontamination stations you need depends on the number of workers, the kind of protection they are using, and the space available.

At first, the warm zone is considered uncontaminated. But as workers leave the hot zone and go through the decontamination, the warm zone gradually becomes contaminated. Contaminated clothing, equipment, and people must not leave the warm zone until they have been decontaminated.

Cold Zone——

This zone is considered clean. No contaminated clothing, equipment, or people may enter the cold zone. People wear normal work clothes in the cold zone. It is a staging area for the cleanup job.

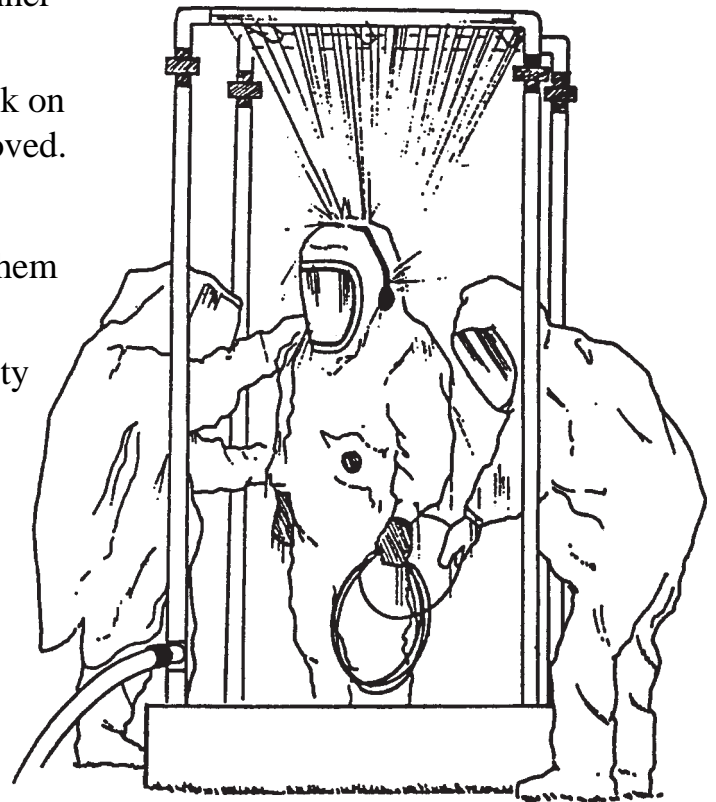
The location of the cold zone is based on: the amount of space available, physical layout, wind direction, distance from the hot zone, and resources available such as telephones, water, reference materials, parking, and ease of access for people coming from outside to work on the spill.

Decontamination Procedures

Decontamination procedures should indicate how equipment and personnel are to be used to control spread of contamination. In some cases entry personnel may be called upon to self decon with the aid of their buddy. In other cases nonentry personnel may be assigned to aid in the decontamination process. A few general rules should be followed during any decon process.

Controlling and containing hazards at the site

- Establish clear procedures for each station on the decontamination line.
- Limit access to those who are supposed to be in the warm zone.
- Allow as few workers as necessary to get close to the source of contamination.
- Control runoff from decontamination showers.
- Regulate entry to and exit from work zones.
- Wear the appropriate PPE while in the decontamination area.
- Discard everything that cannot be thoroughly cleaned. (Stains, discoloration, and visible changes such as blistering are signs that a suit has been affected.)
- When removing CPC do not touch protected areas with outer gloves.
- Do not touch contaminated surfaces with inner gloves or bare hands.
- Always leave breathing apparatus face mask on until clothing has been washed and/or removed.
- Use comfortably tepid water to wash skin.
- Double-bag contaminated items and keep them in the Contamination Reduction Zone.
- Decontamination takes priority over modesty or short-term exposure to cold weather but make every effort to reduce exposure to the elements in cold weather.
- Clothing should be laundered separately at work.
- Wash hair and body thoroughly as soon as possible after leaving the hot zone and before going home.



The Decontamination Process

The lists that follow will give you a rough idea of the order of decontamination—what piece of clothing or equipment comes off when, and what happens to it. The steps shown here apply to “Level A.” At “Level B,” the process is simpler, and some of the steps are eliminated. (See Chapter 3 for more information on levels of protection.)

In the Hot Zone

- Leave tools and equipment you used in the hot zone behind when you leave the zone. Put tools, monitoring equipment, radios, clipboards, and other items on a drop cloth, or in a container, and leave them.
- Wash, rinse, and remove your outer boot covers and outer gloves. (Always wash and rinse them before you remove them.) If your wrist and ankle joints were taped, you should wash, rinse, and remove the tape; then remove the boot covers and gloves.
- Put your boot covers and gloves in a plastic container and leave them.
- The rest of your decontamination must be done in the warm zone.

In the Warm Zone

- Thoroughly wash and rinse your full-body suit and boots before you remove them. This may take several washes and rinses. Use long-handled, soft-bristled brushes and low pressure spray units.
- Remove your boots and deposit them in a plastic container.
- Remove your full-body suit and hard hat.
- Wash and rinse your inner gloves before you remove them. Use water with a detergent, or a decontamination solution, that will not harm your skin.
- After washing and rinsing your inner gloves, but before removing them, remove your SCBA facepiece.
- Deposit the facepiece into a plastic-lined container. Avoid touching your face with your fingers.

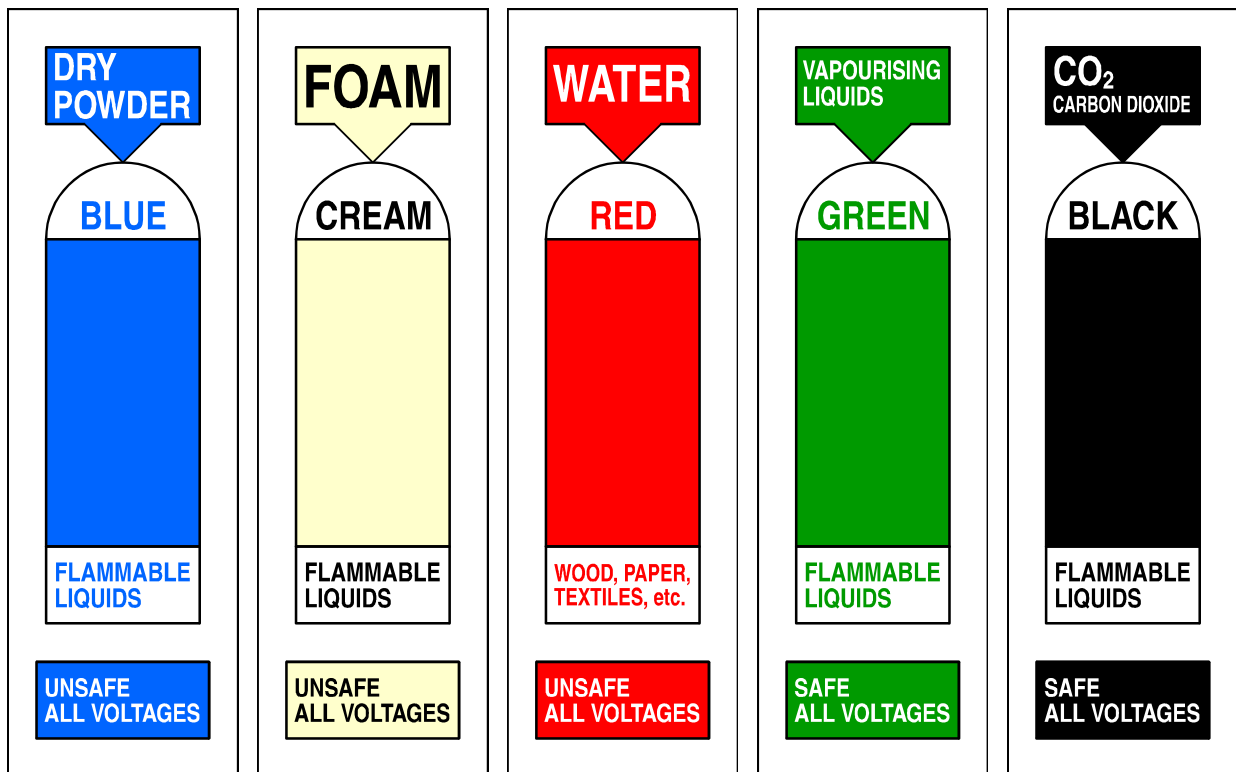
- Remove your inner gloves.
- Remove your inner clothing. Because some contamination may have gotten onto your inner clothing when you were removing the full-body suit, it's important to remove your inner clothing as soon as you can after going through the above steps.
- After decontamination in the warm zone, you should be clean enough to go into the cold zone.

In the Cold Zone

- Shower with soap and water. You should always shower. It is especially important if the chemicals you've been exposed to are highly toxic, are corrosive to the skin, or can be absorbed through the skin.
- Put on clean, uncontaminated clothing.



Fire and Incompatibles



Outline

1. Hazardous Chemical Properties
2. Incompatible Chemicals
3. Fire Hazards
4. Placards and Labels
 - DOT Placards and Labels
 - NFPA Placards and Labels
 - EPA Hazardous Waste Labels

Objectives

Participants will be able to:

1. Determine which chemicals in their workplaces are incompatible and should not be stored together.
2. Explain the three elements of the “fire triangle.”
3. Classify, by the Department of Transportation’s (DOT) hazard classification system, several chemicals commonly encountered when working with hazardous waste.
4. Describe the purpose of the four sections of the National Fire Protection Association (NFPA) Hazard Diamond.
5. List six specific sources of information to identify hazardous materials.

Hazardous Chemical Properties

Hazardous materials are classified according to their properties and behavior. These classifications are used to determine how chemicals should be handled and stored and to predict whether chemicals are incompatible. Understanding these properties is essential in preventing incompatibility reactions.

Common chemical properties include: flammable and combustible, oxidizer, caustic, and reactive. Many chemicals exhibit more than one of these properties. For example, acetic acid is both corrosive and combustible. Likewise, nitric acid is both corrosive and a strong oxidizer.

When storing chemicals, it is very important to know *all* their hazardous properties.

Flammable and Combustible

Flammable—A flammable liquid is a liquid having a flash point below 100°F and having a vapor pressure less than 40 psia.

Examples:

- gasoline
- toluene
- acetone



Combustible—A combustible liquid is a liquid having a flash point at or above 100°F and less than 200°F. Although combustible liquids do not ignite as easily as flammable liquids, they can be ignited under certain conditions and should be handled with caution.

Examples:

- isobutyl alcohol
- methyl cellosolve
- nitrobenzene



Chemicals and conditions which are incompatible with flammable and combustible materials include: oxidizers, certain corrosives, high temperature and pressure, and **any** source of ignition.

Oxidizer

An oxidizer produces oxygen in chemical reactions, making fires burn much more vigorously. Oxidizers are usually liquids or gases, and may also be corrosives.

Examples:

- nitric acid
- sulfuric acid
- chlorine
- flourine
- ozone
- peroxides
- chlorates
- nitrates



Chemicals which are incompatible with oxidizers include flammable and combustible materials, certain corrosives, oils, and greases.

Corrosive

A corrosive, which may be either a solid, liquid, or gas, may react violently with water and organic matter to release heat. This heat may be sufficient to ignite combustible material. Corrosives also cause the destruction of skin at the site of contact. Corrosives are classified as either acids or bases.

Examples:

Acids

- nitric acid
- hydroflouric acid
- acetic acid

Bases

- sodium hydroxide
- potassium hydroxide
- ammonia



Beware: Corrosives may also be oxidizers and flammables or combustibles. For this reason, special care must be taken in storing them. Oxidizing acids (such as nitric and sulfuric acid) and organic acids (such as acetic and formic acids) should never be stored in the same area, even though they are all acids. The latter are combustible, and the presence of oxidizers will make them more prone to fire.

Since acids and bases can react strongly with one another, they should not be stored together

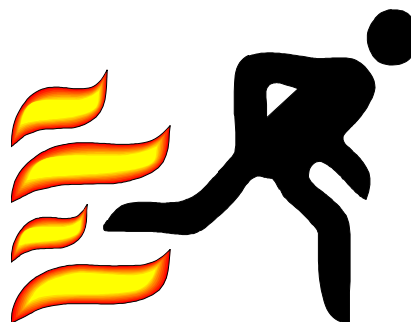
Introducing the Fearsome Incompatibles

In order to handle, treat, store, or dispose of hazardous materials safely you need to be able to evaluate their hazards. Certain properties of hazardous materials, such as flammability, may point to a specific hazard. In addition, physical and chemical properties may determine the ability of a material to undergo incompatibility reactions with other materials.

What do we mean by “incompatibility”? This term describes *undesirable* and *unplanned* reactions between two or more chemicals or materials. Although most incompatibility reactions involve the mixing of chemicals, they can also involve materials such as combustible organics (wood, paper, trash). There are also some chemicals that are highly reactive, even in the absence of other chemicals. In the case of these materials, there is usually some condition, such as air, moisture, or heat, which initiates the incompatibility reaction.

So, what happens when incompatibility reactions occur? The most common outcomes are:

- Heat or pressure is produced
- Fire
- Explosion
- Formation of toxic gases and vapors
- Formation of flammable gases



The particular outcome and intensity of the outcome depend on the chemical reaction, the quantity of the chemicals involved, the temperature, and the pressure.

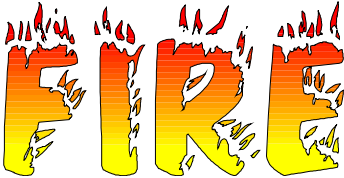


Incompatible Chemicals

Many dangerous chemicals can cause violent reactions when mixed with water, the air, other chemicals, or materials such as wood or paper. Chemicals which cause a violent reaction when mixed are called **incompatible chemicals**.




The violent reactions of incompatible chemicals can result in fire or explosion. They can also result in the production of toxic gases and vapors, flammable gases, and heat or pressure.

It is important to know which chemicals are incompatible. This information tells you how to manage and store chemicals without explosions, fires or toxic gases and vapor.

Incompatibles—Never Store “A” Near “B”

A	B	RESULT
Acids or Bases (Corrosives)	Reactive Metals <i>such as</i> – aluminum – beryllium – calcium – lithium – potassium – magnesium – sodium – zinc powder	
Water or Alcohols	Concentrated Acids Concentrated Bases Calcium Lithium Potassium Other Wastes reactive with water	 Toxic Vapor or Gas
Solvents or Reactive Organic Materials <i>such as</i> – alcohols – aldehydes – nitrated hydrocarbons	Concentrated Acids Concentrated Bases Reactive Metals	

Incompatibles—Never Store “A” Near “B”

A	B	RESULT
Cyanide and Sulfur Mixtures	Acids	
Strong Oxidizers <i>such as</i> <ul style="list-style-type: none"> – chlorates – chlorine – chlorites – chromic acid – hypochlorites – nitrates – perchlorates – permanganates – peroxides 	Organic Acids Concentrated Mineral Acids Reactive Metals	 <p>Toxic Vapor or Gas</p>
	Reactive Organic Solvents Reactive Organic Materials Flammable or Combustible Wastes	



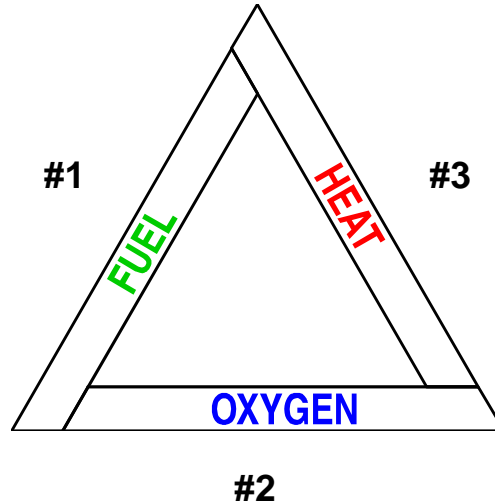
Don't Mix What You Don't Know



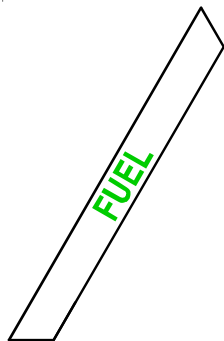
Avoiding the Big Burn: Fire Science

Fires are an important outcome of chemical incompatibility. The fire triangle is an excellent model to understand how a fire starts and how a fire can be prevented.

The Fire Triangle:



In order to start and continue, a fire needs each of the three components of the fire triangle: fuel, oxygen, and an ignition source or heat. In addition, each of these components must be present in the right amount. In most instances, if only two of the legs of the triangle are present, a fire cannot start or be maintained. We'll look at each of these components of the fire triangle in turn.



1. Fuel

Fuels can be present as gases, liquids, or solids.

Examples:

Gases	Liquids	Solids
propane	gasoline	grain dust
methane	kerosene	magnesium filings
acetylene	xylene	aluminum dust

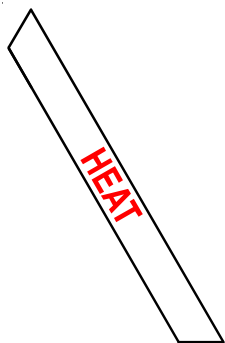
In fact, even if a fuel is present as liquid or solid, it is the vapor form of the liquid or solid that burns.

2. Oxygen

OXYGEN

The most common source of oxygen is air, which contains about 21% oxygen at sea level. Oxygen can also come from chemicals called oxidizers, which can make fires burn much more vigorously.

The practice of using an inert gas, such as nitrogen, to blanket the vapor space above a flammable liquid in a tank keeps oxygen out and prevents the fire triangle from forming.



3. Ignition Source or Heat

Common sources of ignition include: an open flame, a lit cigarette, an electric current, static electricity, a welding torch, and sparks. As mentioned earlier, some chemical reactions produce heat. This heat may be sufficient to ignite a fuel, even without a source of ignition.

Fires can be prevented if the fire triangle is not allowed to form. If you remove the fuel, exclude the oxygen, or eliminate ignition sources, fires can be prevented or extinguished.

The ability of a material to serve as a fuel source is predicted by two factors: FLASH POINT and FLAMMABLE RANGE. The flashpoint and flammable range are specific for each chemical. You can find them on Material Safety Data Sheets, in the NIOSH Pocket Guide to Chemical Hazards, and in other resources listed at the end of this section.

Flash Point—the minimum *temperature* at which a liquid gives off enough vapor to form an ignitable mixture with air. Remember, it is the vapor that burns.

If a liquid has a flash point, it must be considered a potential source of fuel. In general, if a liquid does not have a flash point, it will not act as a fuel. When the flash point of the liquid is lower than room temperature or the temperature at which you work with the liquid, the potential for the buildup of vapor and the initiation of a fire is greater.

Examples:

Chemical	Flash Point (°F)
gasoline	-43
toluene	40
xylene	90

Flammable Range—the minimum and maximum *concentration* of a flammable vapor that allows the spreading of a flame on contact with an ignition source.

This concentration is given as a percentage (%) of the vapor to air by volume.

L.E.L. or L.F.L. (Lower Explosive Limit or Lower Flammable Limit)—the minimum concentration (%) of a flammable vapor which will burn in air.

U.E.L. or U.F.L. (Upper Explosive Limit or Upper Flammable Limit)—the maximum concentration (%) of a flammable vapor which will burn in air.

Examples:	Chemical	L.E.L (%)	U.E.L. (%)
	gasoline	1.4	7.6
	acetone	2.6	12.8
	methanol	6.7	36.0

In order to burn, the concentration or % of the flammable vapor must be between the L.E.L. and the U.E.L. If the concentration is too low, the air-vapor mixture is too “lean.” If the concentration is too high, the air-vapor mixture is too “rich.”

Summary: The lower the flashpoint, the lower the L.F.L, and the wider the flammable range, the better the fuel.

Beware: Since the lowest flammable ranges or the L.F.L. begin at about 1%, it’s important to understand that the air concentration needed to start a fire is very large in comparison to the exposure limits established to prevent health effects.

Many companies have confined space entry procedures that permit entry only when the vapor concentration of the space is less than 10% of the L.F.L. If you get a reading of 10% of the L.F.L on a combustible gas meter, is this level hazardous to your health? This level may indicate that hot work can be done safely inside the confined space, but a reading of 10% would be extremely hazardous to your health.

For example, the L.F.L. for benzene is 1.3% or 13,000 parts per million (ppm). The OSHA Permissible Exposure Limit (PEL) for benzene is 1 ppm, with a Short Term Exposure Limit (STEL) of 5 ppm. If your company allows you go into a confined space at 10% of the L.F.L (in the case of benzene at 0.13% or 1,300 ppm), you would be exposed to a benzene concentration of 1300 times the PEL and over 250 times the STEL!

To Convert From Percent to PPM

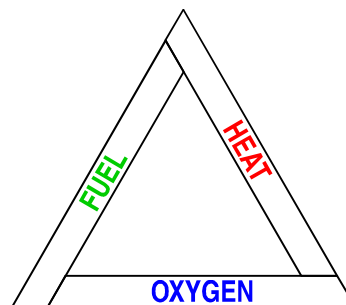
If you want to find out what a concentration given as a percent equals in parts per million, simply move the decimal four places to the right. Using the example of benzene, 1.3% = 13,000 ppm. If you want to convert ppm to percent, move the decimal four places to the left. Again, using the example of benzene, 5 ppm = 0.0005%.

Fire Hazards

Fires and explosions can result when incompatible chemicals are stored together or mixed.

The **Fire Triangle** helps to explain how fires start and how to prevent them.

A fire requires each of these three elements (heat, oxygen, and a combustible material or fuel) in order to ignite and keep burning.



There are three ways to prevent a fire:

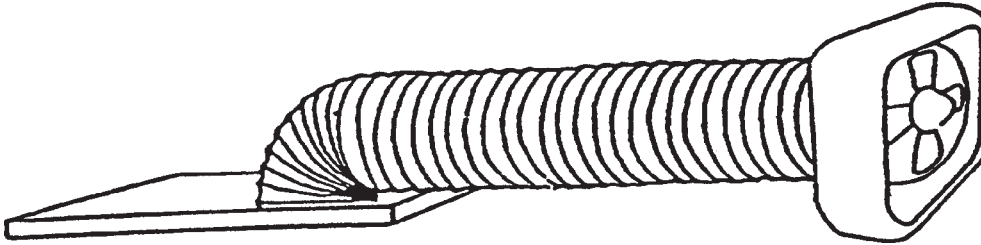
1. Limit the amount of “fuels” or combustibles
 - Keep only necessary chemicals on site (in approved containers).
 - At your work location, keep only those chemicals that are needed for the present job (in approved containers).
 - Limit the amount of hazardous wastes that accumulate at the workplace.

The following are examples of combustibles:

Gases	Liquids	Solids
propane	gasoline	grain dust
methane	kerosene	magnesium filings
acetylene	xylene	aluminum dust

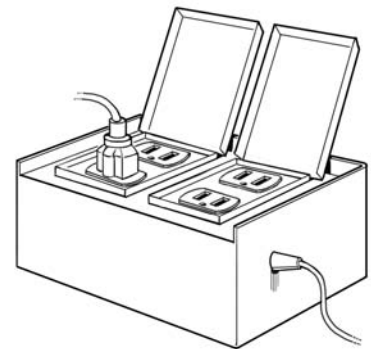
2. Provide proper ventilation

- Remember that a very high oxygen level in the air can lead to an explosion, e.g., with the presence of a spark.



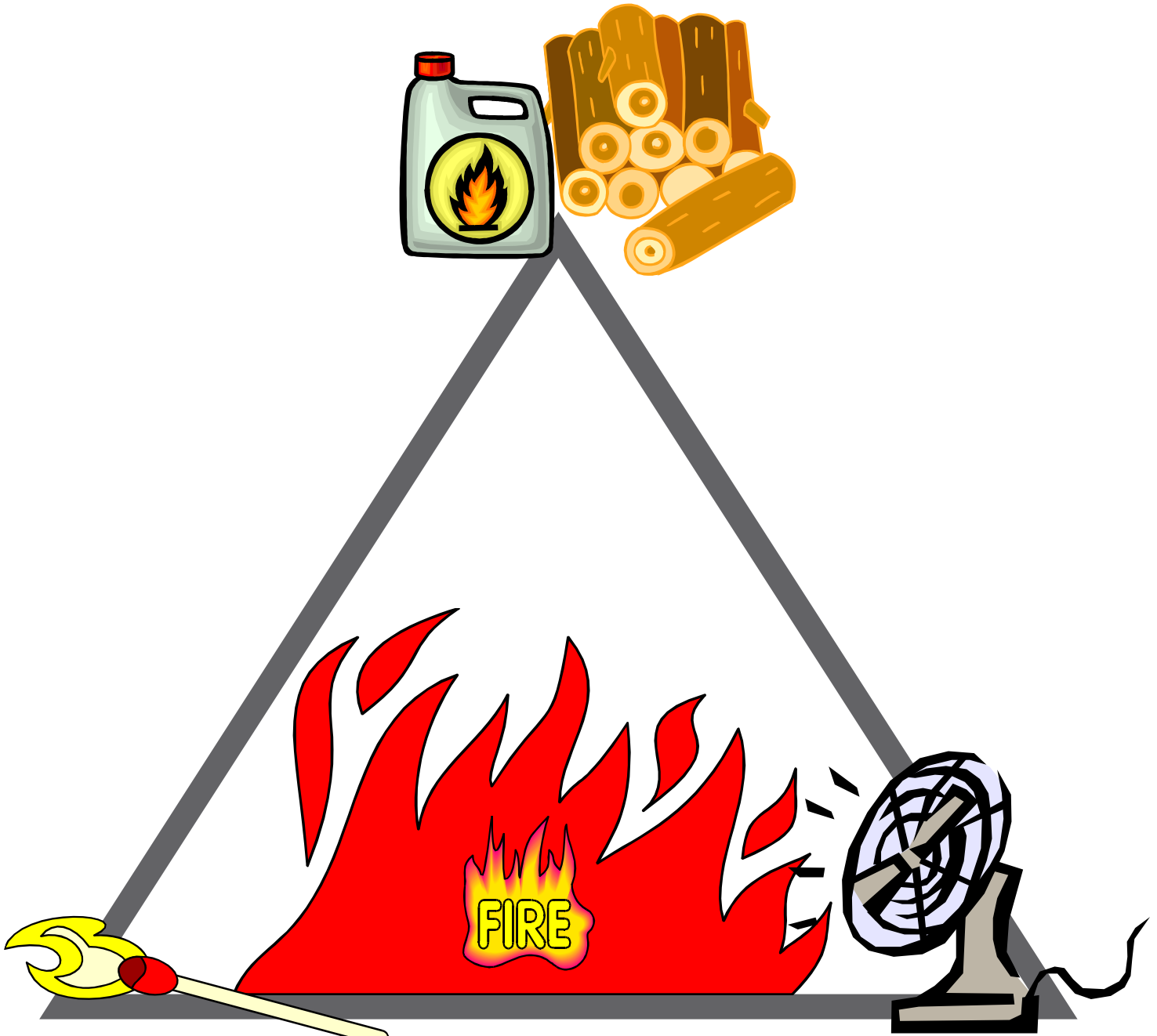
3. Control and inspect for “sparks” and other heat sources

- Ground and bond all work and ignition-proof equipment.
- Examples of heat sources include: flames, lit cigarettes or cigars, electrical cords, sparks, and welding cylinders.



The Fire Triangle

Fuel
Combustible Material



Heat

Oxygen



Workers' Rights



Outline

1. Employer Responsibility
2. Cal/OSHA's Role in Workers' Rights
3. Structure of Cal-OSHA
4. Health and Safety Laws
 - ◆ "Right To Know" About Workplace Hazards
 - Hazard Communication Standard
 - Access to Medical and Exposure Records Standard
 - OSHA Log of Injuries and Illnesses
 - ◆ "Right to Protection" from Workplace Hazards
 - Hazardous Waste Operations and Emergency Response
 - Injury and Illness Prevention Program
 - Confined Space Operations Standard
 - Respiratory Protection Standard
 - Airborne Contaminants Standard
 - California Corporate Criminal Liability Act
 - ◆ "Right To Act" to Improve Workplace Health and Safety
 - Right To Union Representation
 - Right To File a Complaint with OSHA/Cal-OSHA
 - Right To Refuse Unsafe Work
 - Right To Claim Workers' Compensation
 - Right To File a Complaint for Discrimination or Retaliation
5. Steps for Resolving Health and Safety Problems

Objectives

Participants will be able to:

1. Explain the employer's responsibility under the Cal-OSHA General Duty Clause.

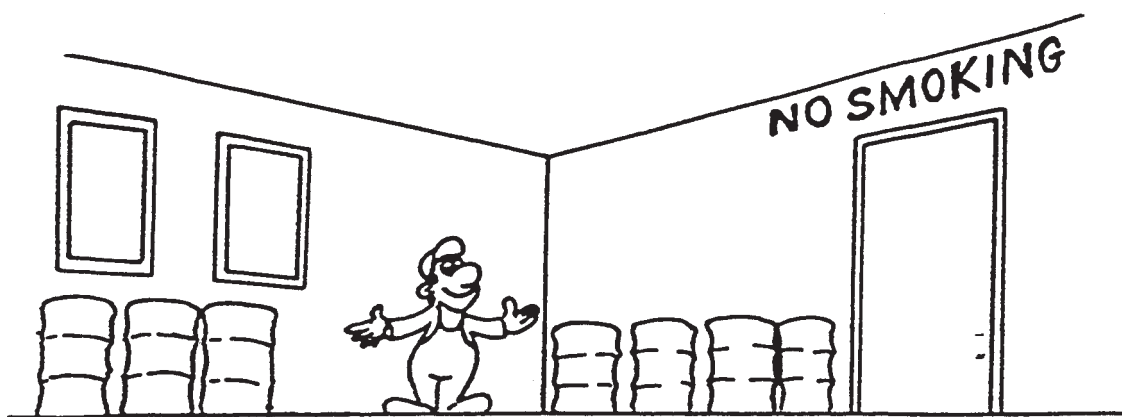
2. Describe at least four rights provided by Cal-OSHA regulations.
3. Apply at least three steps that can be taken to resolve health and safety problems.
4. Identify the steps workers should take if they must refuse to perform unsafe work.

Employer Responsibility

Federal and California laws require employers to provide safe and healthful employment (Federal OSHA: Public Law 91-596, General Duty Clause and California Labor Code, Division 5, Part 1, Chapter 3).

In California, it is the employer's responsibility to provide a safe and healthful work environment. This should include:

- 6400 Every employer shall furnish employment and a place of employment that are safe and healthful for the employees therein.
- 6401 Every employer shall furnish and use safety devices and safeguards, and shall adopt and use practices, means, methods, operations and processes that are reasonably adequate to render such employment and place of employment safe and healthful. Every employer shall do every other thing reasonably necessary to protect the life, safety and health of employees.



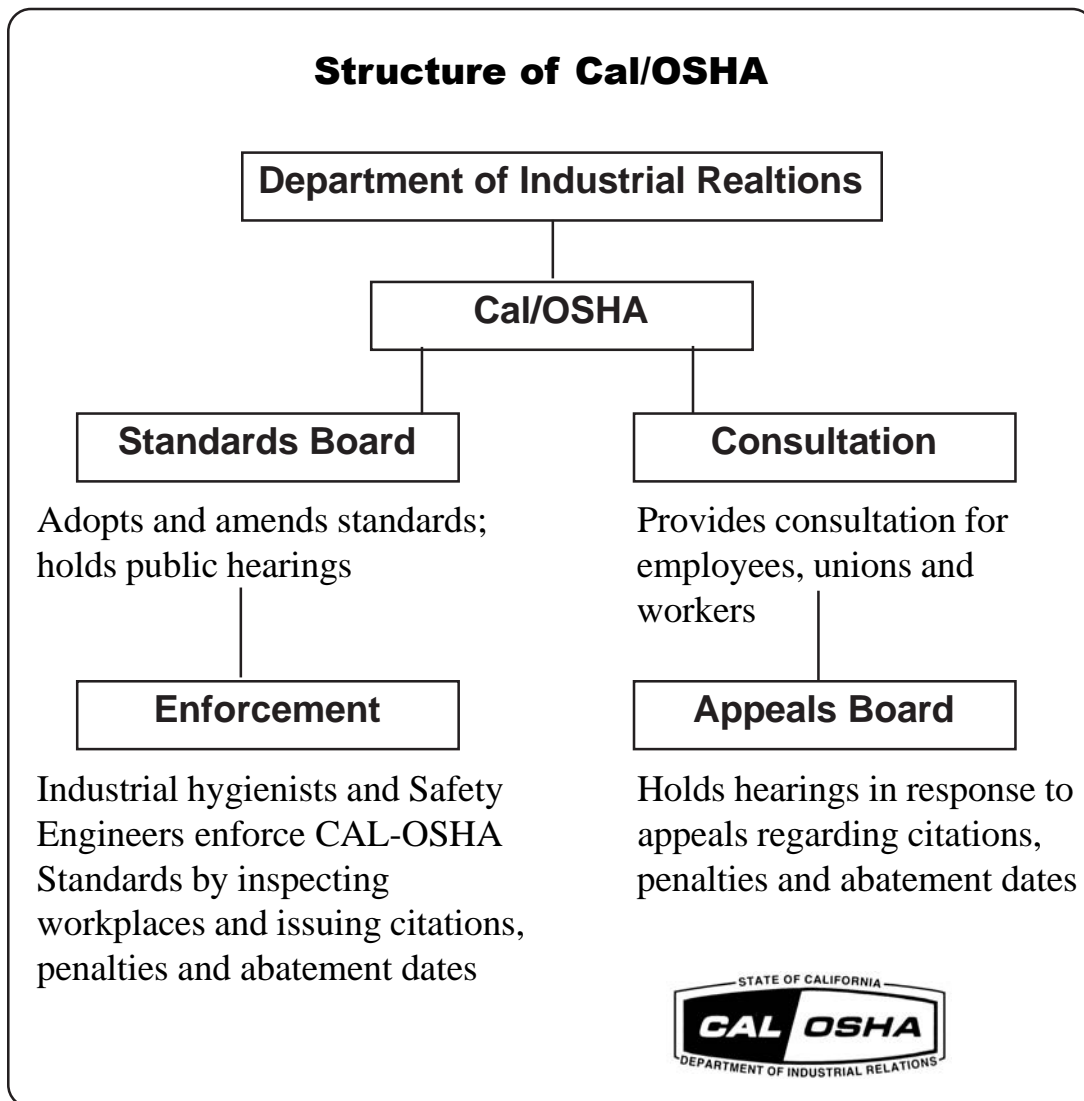
Cal/OSHA's Role in Workers' Rights

The Occupational Safety and Health Act (OSHAct) is the law that provides health and safety protection for private sector workers throughout the country. OSHA (Occupational Safety and Health Administration) is the agency responsible for enforcing the law.

States can also administer their own occupational health and safety programs, but they must be at least as protective as federal OSHA's. State agencies can also provide protection for public sector workers (city, county and state workers) as well as private sector workers.

In California, Cal-OSHA covers private and public sector workers and offers workers more protection than federal OSHA.

To assist employers in meeting their responsibility to provide a safe workplace, Cal/OSHA Standards are compiled in the California Code of Regulations Title 8 (Industrial Relations). Many of the safety standards fall under the General Industry Safety Orders (GISO).



Important Health and Safety Laws

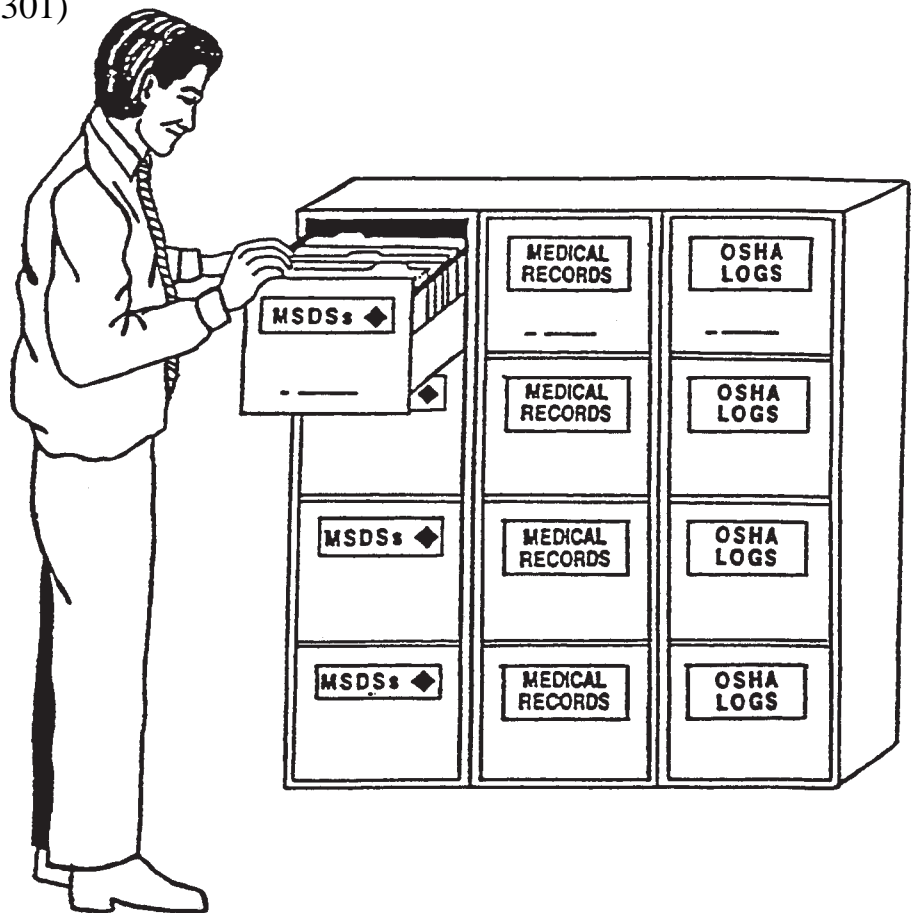
Many of the laws and regulations that provide workers with the right to a safe workplace fit into the following categories:

1. “Right To Know” about Workplace Hazards
2. “Right To Protection” from Exposure to Workplace Hazards
3. “Right To Act” to Improve Workplace Health and Safety

Right To Know About Workplace Hazards

“Right To Know” regulations include:

1. Hazard Communication Standard (GISO 5194)
2. Access to Medical and Exposure Records Standard (GISO 3204)
3. OSHA Log 300 of Injuries and Illnesses (Division of Labor Statistics and Research, Section 14301)



“Right To Know”

Hazard Communication Standard

The Hazard Communication Standard (GISO 5194) gives you the right to information that can answer the following questions:

1. What is hazardous in this material?
2. How can this affect my health?
3. What other hazardous materials are used at my workplace?



Federal and state OSHA programs give workers the right to know what hazardous materials they could be exposed to by requiring employers to set up a “Hazard Communication Program,” including:

- **LABELS** on all hazardous materials
- **MSDSs (Material Safety Data Sheets)** for all hazardous materials
- **TRAINING** for all employees

Labels must include:

- the name of the hazardous substance (the same name as is on the MSDS).
- specific warnings about potential hazards and short- and long-term health effects.
- the name and address of the chemical manufacturer, importer, or other responsible party.

MSDSs must include:

- the product name and ingredients.
- physical and chemical characteristics.
- fire, explosion, and reactivity hazards.
- health hazards: symptoms, routes of exposure, potential to cause cancer.
- legal exposure limits.
- precautions for safe handling and use.
- protective control measures.
- personal protective equipment.
- emergency and first aid measures.
- spill and leak procedures.



Training must include:

- physical and health effects of the hazardous substances.
- methods used to detect the presence or release of hazardous chemicals.
- measures employees can take to protect themselves from hazards (including how to read and use labels and MSDSs to protect themselves).

“Right To Know”

Access to Medical and Exposure Records Standard

The Access to Medical and Exposure Records Standard (GISO 3204) is one of the most important, yet least known, “right-to-know” regulations for workers. This standard gives you the right to information that can help to answer the following questions:

1. What levels of chemicals and other hazards am I exposed to?
2. Do I have a medical problem?

The “**Access to Records**” standard gives you the right to examine and copy certain records kept by your employer. These records include:

- your own medical records
- all workplace exposure records

The “Access to Records” standard does not require your employer to conduct medical tests or monitoring, but it does require the employer to give you access to these records. It also requires your employer to keep the records for **30 or more years**. Your employer must let you see and copy the records you request within 15 days of receiving a written request.

Access can mean one of three things:

1. a free copy provided by your employer;
2. use of copying facilities; and
3. a loan of the record for you to make a copy at your own expense.

Medical Records

Although not required by the standard, your medical records should include all of the following, whether done in-house or contracted out:

- medical histories and questionnaires

- results of laboratory tests
- results of medical exams
- employee medical complaints
- medical opinions, diagnoses and recommendations
- originals of X-rays and interpretations
- description of treatment and prescription

Workplace Exposure Records

Your exposure records should include all of the following, whether done in-house or contracted out:

- monitoring information from personal, area, grab, wipe, or other forms of samples for chemicals, noise, heat, radiation, biological hazards, etc.
- results of tests on blood, urine, breath, hair, etc., for toxic chemicals.
- Material Safety Data Sheet (MSDS). In the absence of MSDSs, you should be given any other record that reveals the identity of a toxic substance or physical hazard.



Confidentiality

Medical records are confidential. You have the right to sign a release to let your doctor or union representative see your records.

Exposure records are not confidential. Union representatives can request all environmental monitoring (exposure) records. They can also request summaries of medical tests, without names, to look for trends (for example, hearing loss among a group of workers).

“Right To Know”

New Cal/OSHA Standard—January 2002

Log 300 of Injuries and Illnesses (Replaces Log 200 reporting requirements) - Begins January 1, 2002.

Under this new Cal/OSHA regulation, every employer with 10 or more employees (except for those in the exemption list) must record an occupational fatality, injury, or illness if it meets one of the general recording criteria: death, days away from work, restricted work or transfer to another job, medical treatment beyond first aid, loss of consciousness, or is a significant injury or illness diagnosed by a physician or other licensed health care professional.

- The log must be kept at the local worksite. When employees do not work at a fixed worksite, as in construction, the worksite is the home base office, or station where the employees are supervised.
- Workers have a right to get a copy of the Log 300, the Annual Summary (Form 300A), and Incident Report (Form 301) by the end of the next business day.
- Employers must record all needlestick and sharps injuries involving contamination with another person’s blood or other potentially infectious materials.
- The Annual Summary must be posted for 3 months, from February 1 to April 30, beginning in 2003.

Why is the OSHA Log Important?

- Although the Log 300 does not list all injuries and illnesses in the workplace, it can provide valuable information about serious hazards and problems that need to be corrected.
- Cal/OSHA reviews these forms when conducting an inspection.
- False or incomplete information can result in large penalties for the employer.

Right to Protection from Workplace Hazards

There are several Cal-OSHA standards that protect workers, including hazardous waste workers. The following standards (found in the General Industry Safety Orders-GISOs of the California Code of Regulations, Title 8) are summarized in this section:

1. Hazardous Waste Operations and Emergency Response (GISO 5192)
2. Injury and Illnesses Prevention Program (GISO 3203)
3. Confined Space Operations (GISO 5159)
4. Respiratory Protection Standard (GISO 5144)
5. Airborne Contaminants Standard (GISO 5155)

Other Cal-OSHA standards may apply to specific hazards at your workplace. Also, the California Corporate Criminal Liability Act, effective January 1991, is enforced by the district attorney's office of each county.

“Right to Protection”



Hazardous Waste Operations and Emergency Response (HAZWOPER) Standard

The Cal-OSHA Hazardous Waste Operations and Emergency Response Standard (GISO 5192) gives you the right to:

1. inspect a written site safety and health plan provided by your employer that addresses the safety and health of each phase of site operations, including requirements and procedures for employee protection.
2. be informed of specific risks at a particular site, including any information concerning chemical, physical and toxicologic properties for each substance known or expected to be present on site.
3. receive health and safety training.
4. receive medical exams where appropriate and without costs.

5. have access to the results of medical exams and monitoring data.
6. inspect a written emergency response plan or emergency action plan provided by your employer.

“Right to Protection”

Injury and Illness Prevention Program (IIPP)

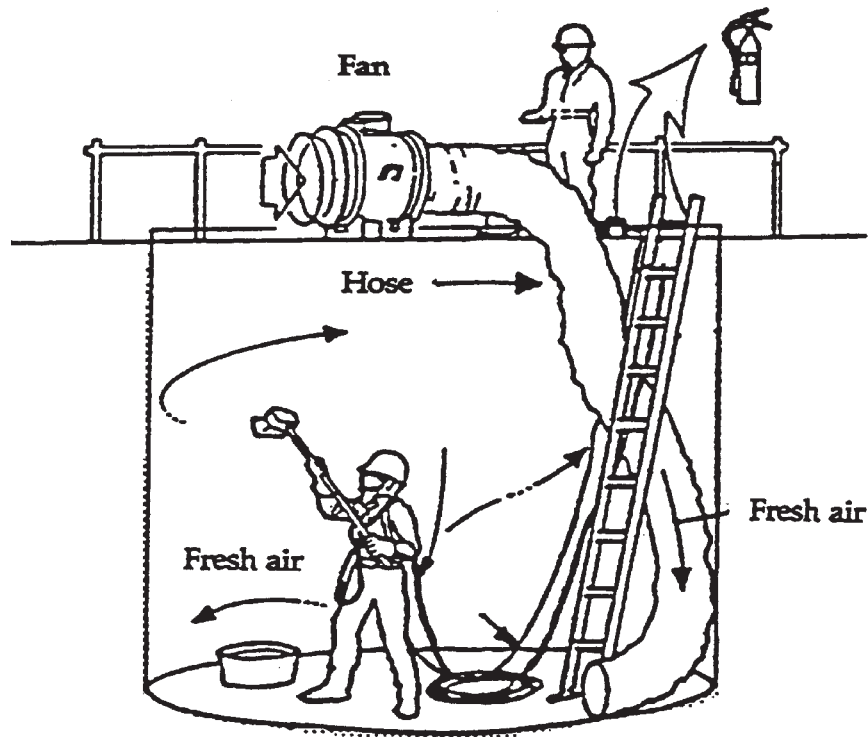
The Cal-OSHA Injury and Illness Prevention Program (GISO 3203) used to be called the Accident Prevention Program. It was updated and renamed in July 1991 as a result of Senate Bill 198. The standard now requires every employer to establish, implement and maintain an effective injury and illness prevention program which is in writing and:

1. identifies person(s) responsible for the program.
2. provides a system for ensuring employee compliance (recognition, training, disciplinary actions).
3. includes a system for communicating with employees (including meetings, trainings, postings, written communications and/or labor/management safety and health committees).
4. includes procedures (including inspections) for identifying and evaluating workplace hazards.
5. includes procedures to investigate occupational injury/illness.
6. includes methods for correction of unsafe/unhealthful conditions, work practices or procedures in a timely manner.
7. provides training and instruction in appropriate language.
8. maintains records of scheduled inspections, action taken to correct problems, and types, dates, and providers of trainings.

“Right to Protection”

Confined Space Operations Standard

The Confined Space Standard (GISO 5157) applies to workers who enter and work within a confined space in which air contaminants (chemicals) are present and/or there is not enough oxygen. (See Section 7 for more information on the Confined Space Standard.)



“Right to Protection”

Respiratory Protection Standard (GISO 5144)

This standard requires that:

1. Respiratory protective equipment be worn when it is not possible to remove harmful dusts, mists, vapors, or gases from the air or when emergency protection against relatively brief exposure is needed.
2. Only MSHA- or NIOSH-approved respiratory equipment be used.

3. Employees be trained in the use and limitations of the equipment they are expected to use.
4. Employers provide, repair, replace, inspect, sanitize, and properly store all respiratory protective equipment that employees may have to use.
5. Breathing air used meets specific medical or breathing oxygen requirements.
6. A written respiratory protection program include: procedures for selection, instruction, cleaning, inspection, and maintenance of respiratory protective equipment.
7. A licensed physician determine the ability of a person to wear a respirator and that the medical status of persons assigned to wear respirators be reviewed at least annually (see Module 7 for detailed information on respirator protection).



“Right to Protection”

Airborne Contaminants Standard (GISO 5155)

This standard lists **legal** limits for the amount of chemicals that may be present in the air at work. It also states whether chemicals can be absorbed through the skin. It lists the Permissible Exposure Limits (PELs) and Ceiling Limits for approximately 700 chemicals. The standard also defines various exposure limit terms (including PEL, Ceiling Limit, Excursion Limit) according to Cal-OSHA.

“Right to Protection”

California Corporate Criminal Liability Act (California Penal Code, Section 387)

The California Corporate Criminal Liability Act (SB 198) went into effect in January 1991. It allows for the prosecution of corporations and/or their representatives in the criminal courts under the jurisdiction of the District Attorney’s office if the corporation or manager:

1. has actual knowledge of a serious concealed danger that is subject to regulatory authority, and
2. fails to take the following action:
 - a. correct the hazard, or
 - b. inform Cal-OSHA and affected employees of the hazard.

If the hazard creates an imminent risk of bodily harm or death, the above action must be taken immediately; otherwise action must be taken within 15 days.

Under this law, failure to notify Cal-OSHA and affected employees can result in criminal prosecution leading to imprisonment and/or fine.

Right to Act To Improve Workplace Health and Safety

You have a right to information and protection according to Cal-OSHA, the National Labor Relations Board (NLRB), and the California Labor Code. You also have the right to discuss health and safety problems with your supervisor or others at your workplace without fear of discrimination.

Rights that are grouped under the “Right To Act” include:

- right to union representation (under the NLRB).
- right to file a health and safety complaint with OSHA.

- right to refuse unsafe work (under the California Labor Code, Section 6311).
- right to claim workers' compensation.
- right to file a complaint for discrimination or retaliation.

“Right To Act”

Right to Union Representation

The national Labor Relations Board (NLRB) oversees federal labor laws. These laws describe responsibilities and rights of employers, employees and unions. Many of these rights can be used to identify and eliminate health and safety hazards.

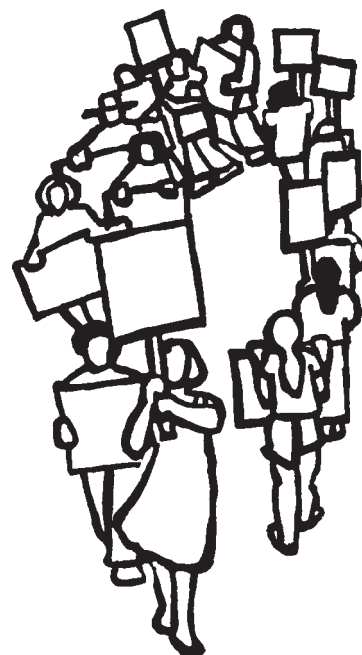
Right to Health and Safety Information: The NLRB gives unions the right to health and safety information in order to bargain intelligently about working conditions.

Unions have requested a wide range of health and safety information, including names of chemicals, MSDSs, monitoring data, group summaries of medical tests, death and pension records, and written company health and safety plans and policies.

If there is a violation of a health and safety contract, it may be faster to ask the union for help rather than OSHA or the NLRB.

Right to an Outside Industrial Hygienist: the NLRB also gives unions the right to bring in a union-designated industrial hygienist to inspect a facility.

Right to Representation without Discrimination: The NLRB requires an employer to bargain in good faith with the representative of the employees: the union. The union must represent fairly and without discrimination all of the employees covered by the contract. This is referred to as “duty of fair representation.”



“Right To Act”

Right To File a Complaint with OSHA or Cal/OSHA

You have the right to file a complaint and request an inspection of your workplace by Cal/OSHA without anyone knowing who made the request. Cal/OSHA responds more quickly to serious hazards and if it knows you have made an attempt to resolve the problem before calling.

In order to request an inspection from Cal/OSHA, call or file a written complaint with one of the Cal/OSHA compliance (enforcement) offices listed below:

Cal/OSHA Regional Offices:

San Francisco	Tel. (415) 557-1677	Los Angeles	Tel. (213) 736-3041
Oakland	Tel. (510) 622-2916	Sacramento	Tel. (916) 263-2800
Concord	Tel. (925) 602-6517	San Diego	Tel. (619) 637-5534
Fresno	Tel. (209) 445-5302	San Mateo	Tel. (650) 573-3812
San Jose	Tel. (408) 452-7286	Santa Rosa	Tel. (707) 576-2356

Cal/OSHA Consultation Offices:

In California, Cal-OSHA Consultation is also available to provide technical assistance to employers and groups of workers. Cal-OSHA consultation services are free of charge. In order to obtain Cal-OSHA consultation services, call one of the following offices in your area:

Oakland	Tel. (510) 622-2891
Fresno	Tel. (209) 454-1295
Sacramento	Tel. (916) 263-2855
Anaheim	Tel. (714) 935-2750
San Diego	Tel. (619) 467-4048
Santa Fe Springs	Tel. (310) 944-9366



“Right To Act”

Right To Refuse Unsafe Work (California Labor Code, Section 6311)

The California Labor Code, Section 6311, says workers can refuse to do unsafe work:

1. if doing the work would create a real and apparent hazard, and
2. if doing the work would violate a Cal-OSHA standard or an order of the California Labor Code.

You have the right to refuse unsafe work, but using this right can be risky if you are not covered by a union. If you lose your job or are otherwise discriminated against after refusing unsafe work, you can complain to the labor commissioner (see p 6-31). However, cases that go to the Labor commissioner can take two to three years to resolve. Refusing work is not something to do “lightly.” Refuse work only in an immediately dangerous situation.

Before you refuse to do an unsafe job, take the following steps:

1. Consult with your co-workers to be sure you are in agreement and that you will not be the only person stating that the job creates a serious hazard.
2. Tell your employer about the unsafe condition and ask him/her to correct the problem before work is done. State that you believe the unsafe condition creates a serious hazard.
3. Contact your union representative.
4. Request an immediate Cal-OSHA inspection.

When you refuse to do an unsafe job:

1. Clearly explain to your employer the reason for refusing to do the work. Make it clear that danger was the only reason for your refusal.
2. Explain to your employer that you are willing to do the work once the corrections have been made. Ask to be assigned to work in a safer area.
3. Stay at or near the job site unless ordered to leave by management.

“Right To Act”

Right To Claim Workers’ Compensation

What is workers’ compensation?

It is a no-fault insurance program for compensating workers and supervisors for work-related injuries, illnesses and deaths, regardless of pre-existing medical conditions. It is financed by employers and administered by the State Division of Workers’ Compensation and the Workers’ Compensation Appeals Board.

What is covered by workers’ compensation?

All employers are required to carry workers’ compensation insurance. Nearly every worker in California is covered by the law. (Railroad, maritime and federal government workers have separate programs with varying benefits.)

How and when should I file a claim?

First, get medical help. Then, notify your supervisor and union, even if you do not have any lost time from work. Generally, you have 30 days to file a claim for an injury, and one year for work-related disease (one year from when you first suffered disability and either knew or should have known it was work-related).

What benefits can I get if I’m injured on the job?

California law gives you four kinds of benefits:

- 1. Medical treatment:** fully paid by the employer for work-related injuries or illnesses. This includes the costs of hospitalization, X-rays, lab studies, and reasonably related transportation expenses.
- 2. Payments to replace lost wages:** benefits are calculated based on whether you qualify for temporary or permanent disability, and are set by state law. Temporary benefits are calculated by taking two-thirds weekly salary, up to \$399 per week (after a 3-day waiting period for most injuries). Public safety officers, however, (and those covered by some collective bargaining agreements), may be eligible for full-salary benefits for a certain time period. Permanent disability benefits are payable after your condition stabilizes. The amount of benefits is subject to your permanent disability rating, which is determined by your injury, your age and

occupation, and your ability to gain employment. Permanent disability benefits generally range from \$168 to \$504 per week.

3. **Vocational rehabilitation services**, available to eligible workers whose disability prevents them from being employed in their usual and customer occupation or the position they occupied at the time of injury, and who can be expected to benefit from a rehabilitation program.
4. **Death benefits** and burial expenses for eligible dependents.

Choosing Your Own Doctor

You have the right to use your own health care provider (with expenses paid by your employer), but you must file a notice with your employer before you are injured. Your employer must notify you of this right. If you have not filed this notice, the employer can select the doctor you see for the first 30 days of treatment. After that time, you can choose your own physician.

“Right To Act”

Right To File a Complaint for Discrimination or Retaliation (California Labor Code Section 6310)

You have the right to file a complaint if you believe that your employer has punished or discriminated against you because you made a complaint to CAL-OSHA or used any other rights under Cal-OSHA law. Discrimination or retaliation might include: firing, taking away your seniority, taking away your benefits, transferring you to an undesirable job or shift, threatening you or harassing you for using your Cal-OSHA rights.

If this has happened to you, contact the nearest office of the California Labor Commissioner (Department of Industrial Relations–Division of Labor Standards Enforcement) for assistance.

When you make this complaint, be prepared to explain:

- what your employer has done to punish or discriminate against you for your job safety and health activities.

- names and addresses of people involved or witness to the punishment. Also, show any documents, letters, or other material that relates to the incident.

When calling the California Labor Commission about filing a complaint, ask to be sent a form or list of information to include in your complaint.

If the labor commissioner finds that your employer has punished you for making a complaint to Cal-OSHA or using any other rights granted to you under Cal-OSHA law, the commissioner will order your employer to return you to your job and to give you any pay or benefits that are due to you. It may take several years to resolve your case. The assistance you receive from the Division of Labor Standards Enforcement or the Labor commissioner is free.

Steps for Resolving Health and Safety Problems

Using these laws and rights to your advantage is not easy. You must be organized and persistent, pressing the company as well as the government to fulfill their legal responsibilities. Here are some tips.

1. Identify the problem and build a strong foundation for your case

- gather information in writing to document the problem. This includes requesting your medical and exposure records and records of past accidents or illnesses.
- document your attempt to get management to correct the problem (notes of meetings, grievances).

2. Know what problem you want to correct and have a timetable

- decide how to correct the problem: develop an outline of demands (which can include bringing in outside technical experts like Cal-OSHA Consultation Services).

3. Involve other workers and keep them informed

- use co-workers as your base of support for advice and direction; this will help you determine which problem(s) affect most people and what solutions are needed.
- work with the union if there is one at your workplace.

4. Bring in a government agency as a last resort

- first, try to solve the problem through direct negotiation with the company; it's faster, easier and there is more control over the outcome.
- decide which government agency to call based on careful research to determine the odds of the agency helping you solve the problem.

5. Persistent follow-up

- participate in all meetings between the company and the agency; keep co-workers informed.



Emergency Response and Planning



Outline

1. What Are Hazardous Materials?
2. If You Don't Know...Assume It's Hazardous
3. Defining What Is an Emergency
4. Spills: Small vs. Large and Why You Need To Know
5. HAZWOPER Requires a Comprehensive Emergency Response Program
6. The Written Plan
7. Worker Training Requirements: Know Your Role
8. Assessing Your Emergency Response Plan

Objectives

Participants will be able to:

1. Define an emergency
2. Describe the Cal/OSHA criteria for a small spill
3. State the priorities in an emergency
4. List the 7 Emergency Response Actions
5. Describe the different roles in an emergency response

What Are Hazardous Materials?

The OSHA/EPA emergency response regulation defines hazardous materials as:

- chemicals that can burn or explode
- chemicals that cause cancer
- poisons
- germs
- radioactive materials
- chemicals that can cause violent chemical reactions.

“Hazardous material” is a legal term. OSHA and EPA have many definitions for hazardous materials.

Some materials are hazardous because they are on a list in the regulations. Other materials have certain properties.

If You Don't Know What Chemical Has Spilled, Assume It Is Hazardous

At any spill, you should assume a material is hazardous until you know for sure it is not. Some hazardous materials have no smell. You may not be able to see it or feel it, but the chemical could be poisoning you. For example:



- You can't smell carbon monoxide;
- You can't see methylene chloride; and
- You can't smell phosgene until there is a dangerous amount in the air.
- You may be able to smell the benzene in gasoline. But it can also soak through your skin and you can't feel it.

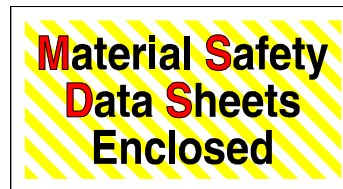
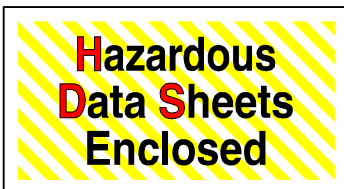


If You Don't Know Exactly What the Dangers Are, Don't Go Near It

Some poisons can soak through your skin and kill you. Other chemicals can creep along the ground and find a flame. Chemicals in cylinders can explode like a rocket. Chemicals can mix and start a fire or give off poisonous gases. **If you don't know exactly how the chemical will act in an emergency, assume the worst.**

By law, your employer has to keep a list of all the hazardous chemicals you work around. You have the right to get a copy of this list. It should include all the hazardous chemicals you use, all of the hazardous chemicals used by people around you (including contractors) **and** anything that is likely to spill! Your employer can get information about chemicals that are carried on trucks in your area from government agencies.

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What Is an Emergency?

In the law, a hazardous materials emergency is a spill or leak that you and your co-workers **in the area** can't handle safely on your own.

It is an emergency if:

- you need special training and equipment to protect yourself from the chemicals;
- you even **think** about calling the fire department or a Hazardous Materials (HazMat) team.

Emergencies include spilling any amount of an unknown or very irritating chemical or spilling a large amount of a chemical. "Large" is defined by EPA, not by your employer. Here are some examples of emergencies:

- A semi crashes and barrels spill out on the side of the road. No one knows what is in them.

- Two chemicals in the lab mix, forcing you and your co-workers out of the room.
- A tank of solvent in an auto shop overflows. All of the brake mechanics—in fact everyone in the shop—are pulled off of their regular jobs to clean up the spill.
- One pound of Chlordane (a very poisonous pesticide) spills in the storage room.

It is your employer's responsibility to decide **ahead of time** which spills you can handle and which ones are emergencies. The union should review the plan and make sure that it protects workers. In an emergency, only workers with special training and equipment may go near the spill. The definition of an emergency is a very important part of your employer's emergency plan.

How Small Is Small?

It depends! Workers **can** handle some spills, especially small spills of less dangerous materials. But you **always** need specially trained workers if:

- The material is very dangerous
- The spill is large (even if the material is not extremely dangerous)
- You don't know what the chemical is
- Chemicals may mix.

Workers can usually clean up:

A small spill of gasoline or diesel fuel

Unless—It has mixed with another chemical. It is on fire.

A small leak (a propane cylinder)

Unless—It is a deadly chemical (like chlorine).

A spill of less than 55 gallons (one drum)

Unless—It has mixed with another chemical. It is a deadly chemical (like styrene).



How Large Is Large?

It depends! What if your employer only wants to call it an emergency if the spill is enormous? The government has a definition of large spills. This is called the **Reportable Quantity (RQ)**. Large spills (bigger than the Reportable Quantity) have to be reported to the Coast Guard. The definition of a spill in an employer's emergency plan may not be bigger than the Reportable Quantity. Here are the Reportable Quantities for a few different materials:

Asbestos	1 pound
Chlorine	100 pounds
Sodium hydroxide (lye)	1,000 pounds

You can find reportable quantities for various chemicals in the *Driver's Guide to Hazardous Materials*. (Your instructor has a copy.)

If any gasoline or oil gets into a river or ocean, your employer must also notify the Coast Guard.

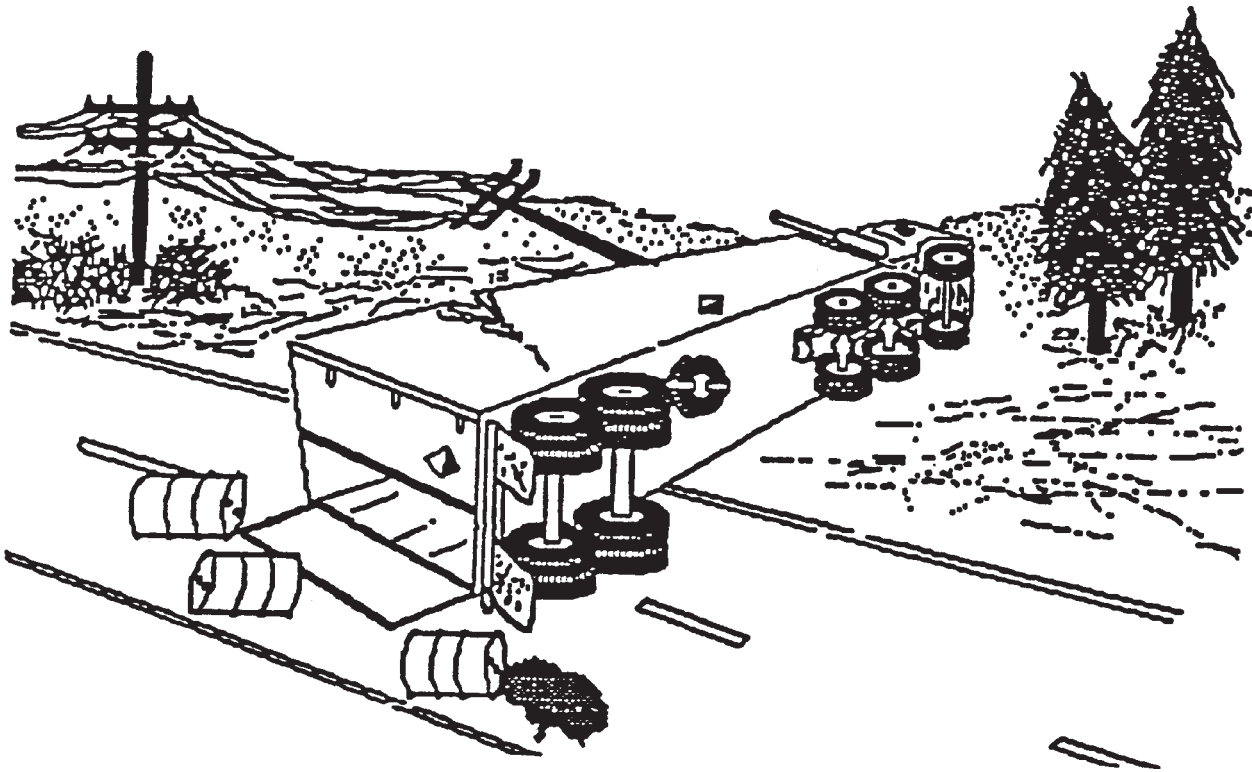


Illustration courtesy of the Midwest Consortium for Hazardous Waste Worker Training. Reproduced by permission.

Types of Emergencies at TSD Facilities

Fire and explosions are probably workers' top concern because they have the potential to escalate from small to extremely large and serious emergencies. That's why fire brigade teams are so important.

But industrial plants with TSD areas must also be prepared for other kinds of emergencies. The facility's emergency response plan should have detailed response procedures for all emergencies that the employer may reasonably expect in the workplace. Often two or more factors come together to create an emergency situation.

Below is a partial list of possible emergencies. Use your own experience and knowledge of your workplace to add to it. You can then use it as a checklist to evaluate how complete your facility's plan is:

- Fires
- Explosion
- Leak of product
- Spills
- Power failure, loss of utility
- Pressure vessel failure
- Equipment failure
- Mechanical problems
- Release of toxic vapors—vapor clouds, radioactive materials
- Reaction of incompatible chemicals
- Discovery of radioactive materials
- Natural disasters (earthquakes, floods, hurricanes, tornadoes)
- Personal Protective Equipment failure (air source failure, tearing or permeation of protective clothing, facepiece fogging)
- Chemical and radiation overexposure
- Medical problems (heat stress, heart attacks)
- Physical injury (serious accidents or falls, injury from flying objects, trenching or confined spaces hazards)
- Malfunction of alarms and monitors
- Bomb threats
- Weather changes (rain, lightning, extreme heat or cold)

Do the Right Thing: Stop and Think Before You Act

Your first instinct in an emergency is probably to jump in and help, particularly if a co-worker is in trouble. But in a hazardous materials emergency, trying to save someone's life could cost you your own. You could do more harm than good. Workers who respond to hazardous materials emergencies need special training—up to 40 hours—and special equipment.

Below are two examples of what can happen to unprepared workers during a spill:

Untrained Worker Cleans Up Styrene Spill; suffers serious injury and wins \$1 million award

Chemical worker Joe Darvis was ordered to clean up a chemical spill after a drum containing styrene was punctured by a forklift earlier in the day. The supervisor said a respirator was not needed. The drum was marked “Flammable Liquid, N.O.S. Flash Point 86 B F, UN 1993.” Worried about the risk of explosion, Darvis grabbed a shovel and spent about 40 minutes loading the chemical into four boxes, which he dumped in a nearby dumpster.

He later suffered serious health problems. A jury awarded him \$1 million because the company failed to properly label the chemical, warn Darvis of the risks, or provide proper PPE.

Power Failure Causes Runaway Chemical Reaction: Kills Poorly Trained Emergency Responder

A power failure in a chemical plant caused a chemical to rapidly decompose, releasing dangerous hydrogen sulfide and sulfur dioxide gases.

Two workers, exhausted by the emergency response efforts, removed their self-contained breathing apparatuses and inhaled high levels of toxic gases. One worker died instantly and the other was hospitalized.

The company was fined \$250,000 for failure to provide refresher training for emergency responders, and failure to train employees, contractors and outside responders on the specific health hazards in the work area. They were also fined for failure to provide a source of backup electrical power.

Source: BNA Occupational Safety & Health Reporter, 3/9/2000.

Summary:

What Are Hazardous Materials Emergencies?

1. Hazardous materials include:
 - chemicals that can burn or explode
 - chemicals that cause cancer
 - poisons
 - germs
 - radioactive materials
 - chemicals that can cause violent chemical reactions.
2. If you don't know what chemical has spilled, assume it is hazardous.
3. If you don't know exactly what the dangers are, don't go near it.
4. A hazardous materials emergency is a spill or leak that you or your co-workers **in the area** can't handle on your own.
5. It's your employer's responsibility to decide **ahead of time** which spills you can handle and which ones are emergencies. The union should review the plan and make sure it protects workers.
6. Shutting off a valve, putting dirt on spilled material, or rescuing someone could poison you, start a fire, or set off an explosion. "Doing the right thing" could be the wrong thing in a hazardous materials emergency.
7. Workers who respond to hazardous materials emergencies need special protective equipment and training. Workers who handle hazardous materials during a spill must have at least 40 hours of training.



Hazardous Waste Response Standard Requirements for Emergency Response

The Hazardous Waste Operations Standard requires all employers at hazardous waste sites and treatment, storage and disposal (TSD) facilities to develop and use **an emergency response program**. This program should include the following:

1. A **written plan** that is available for all workers and OSHA inspectors to see and copy (see the next page). This plan is a section of the overall site safety and health plan.
2. **Specific training** for the use of emergency response equipment.
3. **General training** for workers who are not directly responsible for responding to emergencies.
4. **Regular practice** of the emergency plan as a part of the overall training program for site operations.
5. **Specific steps** explaining the role of the employer during an emergency.

For more information, see CCR Title 8, GISO 5192, paragraph (1).



Your Employer's Written Emergency Plan

By law, your employer has to plan for emergencies like this one **before they happen**.

The **written** plan has to include the following information:

- The definition of an emergency
- What chemicals are used, and how they could spill
- How spills can be **prevented**
- If chemicals do spill, who is qualified to respond, and at what level
- How to contact emergency responders
- What kind of training is required for different levels of response
- How your employer will work with the fire department, HazMat teams, and other outside groups
- Who is in charge at the emergency and who reports to who
- How the spill should be cleaned up
- What protective equipment cleanup workers will need
- Whether anyone must be evacuated, and how that will be done
- Safe places to go in an emergency
- How to account for all workers in an emergency
- How to keep bystanders out of the area
- How workers will be cleaned off (decontaminated) if they accidentally get chemicals on them
- Who will give emergency medical care to chemical victims
- How the program will be evaluated for weaknesses and improvements

Worker Training Requirements: Know Your Role

TSD workers may work in situations where they are likely to be the first to spot an emergency. They are called “Awareness-level first responders.”

Sometimes we are expected to do something for which we haven’t been properly trained or equipped. If workers are expected to respond to hazardous materials emergencies, OSHA law now says that all employers must divide their workforces into five levels of emergency responders.

The five levels of responders, in order of increasing responsibility, are:

- First Responder, Awareness Level
- First Responder, Operations Level
- Hazardous Materials Technician (Hazmat)
- Hazardous Materials Specialist
- On-Scene Incident Commander (IC)

Training First

According to OSHA, you have to be properly trained and equipped **before** your employer can expect you to respond at your designated level. Contractors must be trained too.

Check Your Plan

Your employer’s emergency response plan should describe in detail in which level everyone fits. A good plan should also clearly describe contractor duties during an emergency.

First Responder Awareness Level: Call Someone and/or Sound the Alarm and Run

You need to know who to notify and where to run. This applies to most SEIU members.

First Responder Operations Level: The Defense Team

They act defensively from a safe distance. They put down sand to keep a spill from spreading. They **do not** try to stop a leak. They need special equipment to protect themselves. Your employer may choose to train a small crew for the operations level.

Hazardous Materials Technicians: The Offense Team

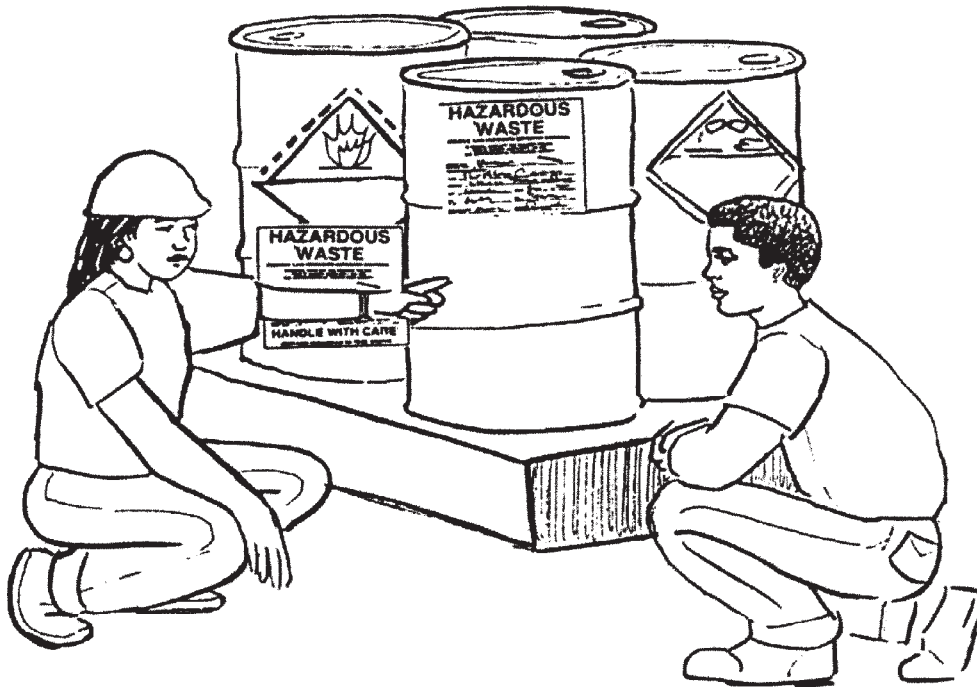
They take offensive actions to stop the release and wear specialized protective equipment. Extensive training is required, beyond fire brigade training.

Hazardous Material Specialists: The Experts

These people are special assistants to the Hazmat team.

On Scene Incident Commander: The Emergency boss

The one person authorized to make all key decisions during emergencies.



OSHA Awareness level: Call someone and/or sound the alarm

“First responders at the awareness level are individuals who are likely to witness or discover a hazardous substance release and who have been trained to initiate an emergency response sequence by notifying the proper authorities of the release. They would take no further action beyond notifying authorities of the release.”

OSHA Operations level: Act defensively from a safe distance

“First responders at the operations level are individuals who respond to releases or potential releases of hazardous substances as part of the initial response to the site for the purpose of protecting nearby persons, property, or the environment from the effects of the release. They are trained to respond in a defensive fashion without actually trying to stop the release. Their function is to contain the release from a safe distance, keeping it from spreading, and prevent exposure.”

OSHA Technical level (HazMat team): Offensive team, extensively trained

“Hazardous material technicians are individuals who respond to releases or potential releases for the purpose of stopping the release. They assume a more aggressive role than a first responder at the operations level in that they will approach the point of the release in order to plug, patch or otherwise stop the release of a hazardous substance.”

OSHA Specialist level: The experts

“Hazardous Materials Specialists are individuals who respond with and provide support to hazardous material technicians. Their duties ... require a more directed or specific knowledge of the various hazardous substances they may be called upon to contain. The hazardous materials specialist would also act as the site liaison with Federal, State, local and other governmental authorities in regards to site activities.”

OSHA Incident commanders: The emergency boss

“Incident commanders [are individuals] who will assume control of the incident scene beyond the first responder awareness level.”

Cal/OSHA Criteria for Incidental Spills

1. The spill response is addressed in the IIPP, and responding employees have been trained.
2. Someone with sufficient training has determined that it is not an “emergency.”
3. Employees have had HAZCOM Training.
4. The substance is identified.
5. Employees have been trained on the hazards of the chemical, the clean-up procedures, what precautions they need to take to protect themselves, how to detect over-exposure, etc. (hazcom).
6. Employees have been furnished with proper protective equipment, and training in the equipment.
7. The proper equipment is available to clean up the spill safely.

Assessing Your Emergency Response Plan

By law, every employer in California needs to be prepared to respond to an emergency. The California Occupational Safety and Health Administration (Cal/OSHA) requires that employers who have chemicals in the workplace train workers about the possible hazards of working with chemicals, and provide training for all employees about the difference between a hazardous materials emergency and a small spill. The Cal/OSHA standards that require this training include:

- Hazard Communication (“Right to Know” law; GISO 5194)
- Injury and Illness Response Plan (IIPP; GISO 3203)
- Hazardous Waste Operations and Emergency Response (HAZWOPER; GISO 5192)

The following two checklists are developed based on information in these standards. They are designed to help you evaluate your worksite emergency response plan and be clear on your role in an emergency or small spill.

Pre-Emergency Planning Checklist: Are We Prepared?

1. Sizing up the situation

- I've received Hazard Communication training, including information on:
 - how to protect myself from the dangers of the chemicals I work with
 - the signs of overexposure to the chemicals I work with
 - where to get additional information (labels and Material Safety Data Sheets) on the chemicals I work with
 - when to use personal protective equipment, including how to clean, store and wear it correctly.
- I know the location of the most hazardous chemicals in the building.
- I've received training on what to do in case of a chemical spill:
 - I know the person to contact who has sufficient training to determine the difference between a small spill that can be safely cleaned up vs. an emergency **and/or**
 - I have received sufficient training to be able to make a safe judgement about the difference between a small spill and an emergency.

2. Alert

- The company has an evacuation alert system that reaches all employees.
- The company has tested the evacuation alert system.
- I know how to activate the emergency evacuation system if necessary.
- I have seen and been trained on the company's emergency response/evacuation plan.
- I know who is "in charge" in an emergency.

- The company has a clear “chain of command” with back-ups (a contingency plan) if primary people are absent.
- Communication equipment is readily accessible throughout the building.
- The company has a way to alert neighboring businesses and homes of a spill.
- I know what my role is, and what to do if a spill occurs, including:
 - Where to go
 - Who to call
 - What to report (name of chemical, size of release/spill, employees affected, any additional information that could be helpful).

3. Get Out

- I know the evacuation plan.
- I know the company’s designated meeting place outside the building.
- I could easily walk out of the building even with the lights out.
- We have practiced the evacuation plan.
- Exits are clearly marked and accessible.
- The company keeps a daily list of on-duty employees that will be brought to the designated meeting place in an emergency.
- Other.

When an Incident Occurs: Checklist

1. Size-up: Is it an emergency or small spill?

You should be able to answer YES to all the following questions in order to determine if this is a small spill that you can safely clean up. If you answer NO to any of these questions, go immediately to Alert:

Yes No

- | | | |
|--------------------------|--------------------------|--------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|
| <input type="checkbox"/> | <input type="checkbox"/> | I've received training on what to do in case of a chemical spill: |
| <input type="checkbox"/> | <input type="checkbox"/> | I know the person to contact who has sufficient training to determine the difference between a small spill that can be safely cleaned up vs. an emergency and/or |
| <input type="checkbox"/> | <input type="checkbox"/> | I have received sufficient training to be able to make a safe judgement about the difference between a small spill and an emergency and can answer yes to the following information: |
| <input type="checkbox"/> | <input type="checkbox"/> | I know when to notify my supervisor and/or spill response coordinator about the spill to get their input and guidance about how to respond. |
| <input type="checkbox"/> | <input type="checkbox"/> | I know what the chemical is and how hazardous it is. |
| <input type="checkbox"/> | <input type="checkbox"/> | The chemical is not mixing with other chemicals. |
| <input type="checkbox"/> | <input type="checkbox"/> | The chemical is not extremely hazardous. |
| <input type="checkbox"/> | <input type="checkbox"/> | know the signs of overexposure to the chemical. |
| <input type="checkbox"/> | <input type="checkbox"/> | Personal protective equipment is available and in usable condition. |
| <input type="checkbox"/> | <input type="checkbox"/> | I've been trained in how to safely clean up this chemical and how to use the personal protective equipment (PPE) correctly. |
| <input type="checkbox"/> | <input type="checkbox"/> | Staffing is adequate to clean up the spill. |
| <input type="checkbox"/> | <input type="checkbox"/> | Clean-up equipment is accessible and in usable condition. |

2. Alert

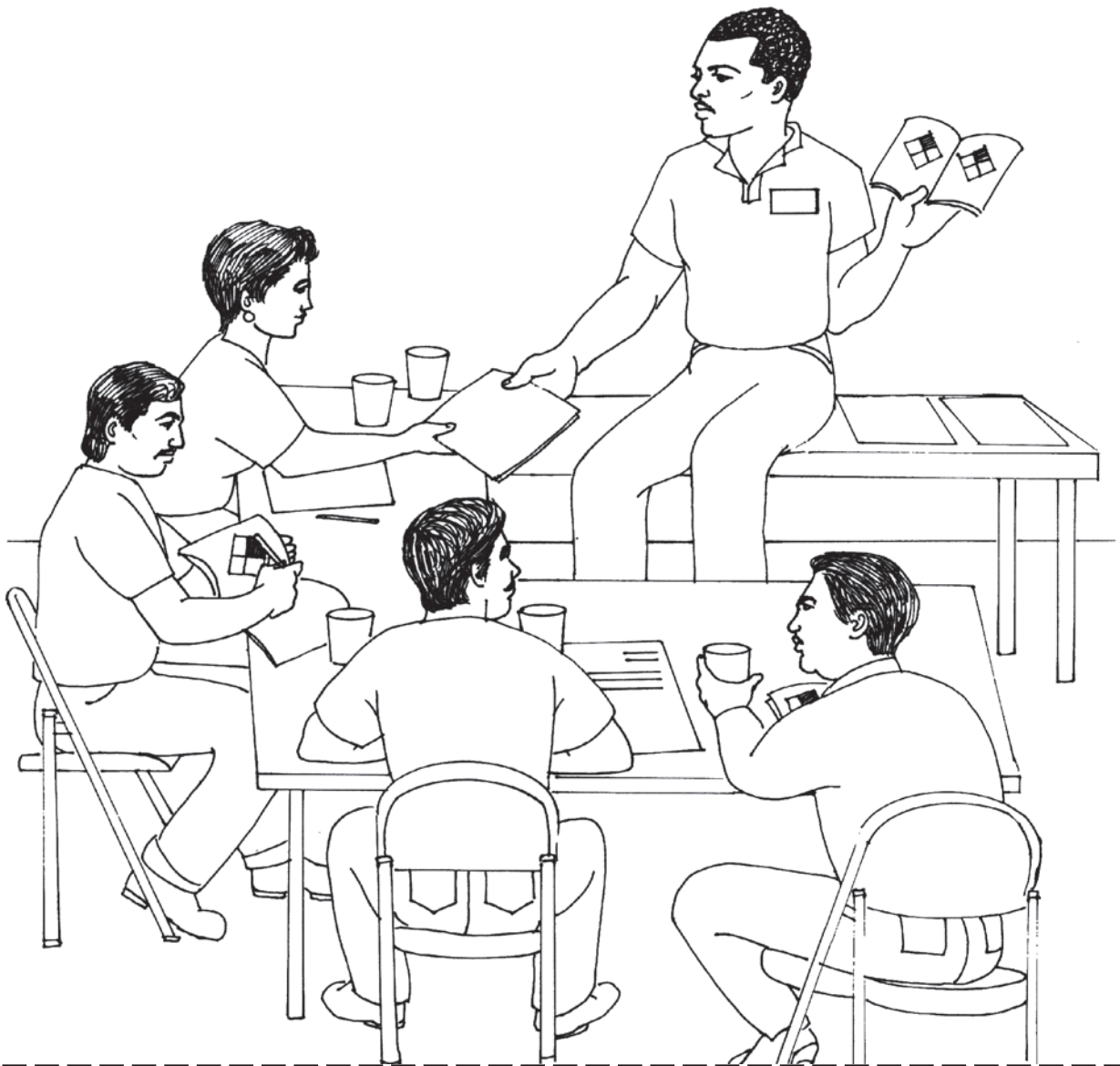
- Notify co-workers in immediate area.
- Leave immediate area.
- Report incident as trained:
 - What happened? (name of chemical, size of release/spill, employees affected)
 - When did it happen?
 - Where did it happen?
 - Is anyone injured, contaminated or trapped?

3. Get Out

- Evacuate building as trained.
- Double check that your closest co-workers are with you; if not, notify the person in charge.
- Go to the designated meeting place outside the building.
- Check in with the supervisor of the meeting place to check off your name.



Strategies To Improve Health and Safety Back on the Job



Outline

1. Collecting Information About Workplace Hazards: Steps To Consider
2. Tools for Collecting Information
3. Health and Safety Survey
4. Planning for Action
5. Developing Your Action Plan
6. Evaluating Your Action Plan
7. Follow-Up

Objectives

Participants will be able to:

1. Identify how they can find out more about a health and safety problem by:
 - Gathering information/tools
 - Using resources
 - Talking with others on the job
2. Describe how to develop a plan/problem-solving strategy. What are the ways, steps, and strategies to solving a problem? What are all the possible ways of solving a problem?
3. Describe how to take these ideas back to their workplace

Collecting Information About Workplace Hazards: Steps To Consider

1. What are you trying to find out?

You may be trying to find several types of information, but the more focused your objectives are, the easier it will be. Set clear objectives, and keep your search as simple as possible. For example:

- Are you concerned about a health issue community members have raised?
- Are you doing a general survey of the workplace, to later target key concerns?

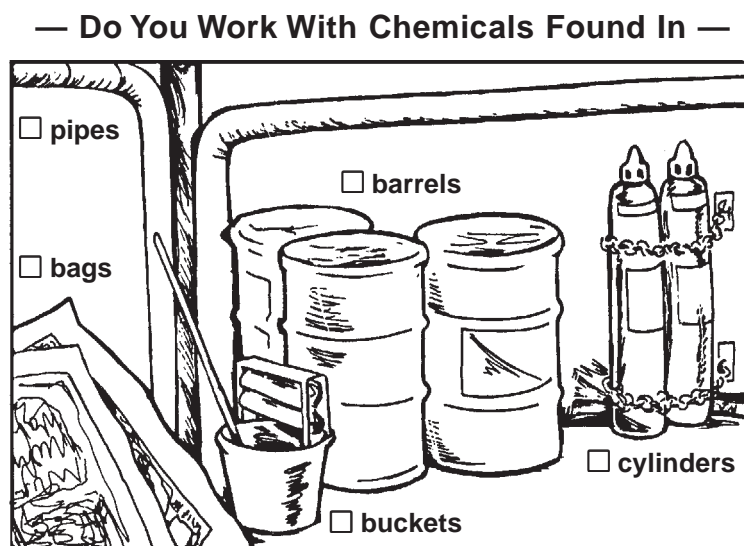
2. Which tools will work best?

Consider the list of possible sources of information.

- Which of these are possible for you to use?
- Which will provide you with the information you want?

3. Plan your information gathering systematically

- What information do you need first (to help with later steps)?
- Who is appropriate to collect which types of information?



Tools for Collecting Information

- On-site Inspection Checklist
- Worker surveys or interviews
 - ___ Health symptoms?
 - ___ Hazards they can describe?
 - ___ Protective equipment they use?
 - ___ Worker concerns?
- Any documents available from the employer
 - ___ Accident, injury, or illness reports
 - ___ Monitoring records by the employer or others
 - ___ Inspections by government inspectors
 - ___ Inspections by insurance companies
 - ___ MSDSs
 - ___ Other _____
- Monitoring information from other organizations
- Information on worker injury/illness from local agencies
 - ___ Health clinics
 - ___ Other non-governmental organizations
 - ___ Labor unions
- Local health and safety resources
 - ___ Labor unions (check for collective labor agreements)
 - ___ Health and safety committee
 - ___ Local universities or libraries
- Other _____

Health and Safety Survey

The union is distributing this questionnaire to learn more about health and safety conditions in the workplace. With your help, we may be able to win health and safety improvements in the next contract. Answer each question as completely as possible.

Name (optional) _____

Location and Department _____

Title _____ Years at This Job _____

1. Have you ever been injured at work? Yes No

If yes, please describe:

2. Have you ever had an illness that seemed related to your job? Yes No

If yes, please describe any symptoms you have had (for example, coughing, back pain, wrist pain, dizziness, etc.):

If yes, please describe how the symptoms seemed related to your job:

3. Do you work with chemicals? Yes No

If yes, chemical names:

4. Have you ever been trained about toxic chemicals and other hazards in this workplace? Yes No

5. Do you use personal protective equipment (PPE), like a respirator, hard hat, or gloves? Yes No

If yes, please list:

6. If you use PPE, do you always receive the right equipment and is it in good condition? Yes No

If no, please describe:

7. Has Cal/OSHA ever conducted an inspection of your workplace? Yes No
 Don't know

If yes, please describe:

8. Describe any areas or conditions in your workplace that you consider hazardous.

9. What do you think is the most important health and safety improvement needed?

10. Do you know of any coming workplace changes that might affect worker health and safety? What changes do you expect, and what problems might they cause?

Planning for Action

Once you have decided to try to take action on a health and safety issue, you need to do some planning. Review these points to help develop a plan of action. You may consider several of these things at the same time.

Analyze the Problem

- What are the health and safety problems or issues you want to tackle?
- Evaluate the work processes and types of work people are doing:
 - How many people do this particular task?
 - When do they do the work?
 - How often are they exposed to the hazard?
 - Are workers having health problems?
- What are different ways you can get more information about these issues?
(See the “Tools for Collecting Information” checklist)
- Can you or the workers or community members involved approach workplace management to get information or talk about health and safety issues?
Evaluate why or why not.
- What steps, if any, have people already taken to try to resolve the problem?
 - Met with the employer to talk about the issue?
 - Talked with a community group?
 - Filed a grievance or complaint through the union?
 - Contacted outside resource agencies?
 - Surveyed people affected by the issue?
 - Other?

Analyze Strengths and Barriers

- What are all the possible ways you might resolve the issues?
 - How could you eliminate the problem?
 - How could you reduce the problem or exposure?
 - How could you protect the individuals who are impacted by the problem?

- Is your target audience ready to participate as a group to discuss and work together on these issues?
- Are there language and/or cultural issues you need to consider?
- Does your group have documentation to back up your position?
- What resources will you need as you work on this issue?
- What other factors do you need to consider as you develop your strategy?

Develop Short and Long Term Goals

- What are your organization's short and long term goals?
- How does this issue connect to work you are already involved with?
- How could working on this issue help further the goals and work of your organization?
- What would you like to achieve over the next:
 - 3 months?
 - 6 months?
 - Year?

Identify and Involve Your Target Audience

- Who is impacted by these issues? (workers, community, local groups, other countries, the environment, the economy, etc.)
- Who are possible allies in working with you on these issues?
- Is there a local NGO that works with your target audience already that could get involved?
- Are their unions or other advocacy groups that could get involved?
- What kind of community event could help you identify and/or involve your target audience? (community health fair, demonstration, press conference, distribution of leaflets, house meetings, other actions)

Choose the Issue You'll Work On First

- Which issue is most important to your group, and why?
- Which issue may be easiest to resolve, and why?
- Which issue is hardest to resolve, and why?
- What are the cost factors involved with resolving various issues?
- Which issues will unite people, and why?

Developing Your Action Plan

You must develop an Action Plan that will serve as a road map for achieving your goal. The components of an action plan include:

- WHAT** List all the different things that need to be done, step by step.
- WHEN** Develop a timetable for accomplishing each task, and write the tasks into your action plan chart.
- WHO** Be sure someone is responsible for getting each task done on time. Keep people accountable. Recruit more activists!
- WHERE** Decide on the most appropriate or advantageous locations for meetings and events.
- HOW** Inventory what resources you have available to help you reach your goal. Be creative and inventive. **People** are the most important resource you have!

Involving people in meaningful ways and effective communication are keys to developing and carrying out any effective plan for action.



Action Plan

What are the 3 health and safety problems in your workplace that concern you most? Think about everything we have covered in this course. (For example, MSDSs are not available, etc.) *Be specific and rank them in order of importance with number 1 being the most important.*

1.

2.

3.

For each of your health and safety concerns, what do you need to do to solve the problem? What does your employer need to do?

Problem #1

What I need to do

What my employer needs to do

Problem #2

What I need to do

What my employer needs to do

Problem #3

What I need to do

What my employer needs to do

What obstacles do you think you might encounter in trying to improve the level of health and safety in your workplace?

Of all the things **you need to do** (listed above), which **one** can you realistically do in the next 3 to 6 months?

Evaluating Your Action Plan

By making periodic checks on the progress of your action plan, you avoid the frustration of finding out too late that it is not working out.

Ask yourself questions such as:

- Are we still on schedule?
- Are our plans still feasible?
- Did we leave anything out?
- Have things come up that we did not think of before?
- How do we handle them?
- Does new information or changes in the situation suggest changes?

At the completion of your action plan, you want to evaluate how well you did so you can learn for the next time.

Some of the questions to ask are:

- Did we meet our goal?
- Did our action plan accomplish what we expected?
- How many people did we include and involve?
- What did we do that was most effective?
- What did not work?
- How did we handle unexpected situations?

Follow-Up

Follow-up on the evaluation. The next steps to take depend on the results of your efforts.

... We accomplished our goal,

THEN ... Celebrate! Let everyone know. It was a lot of work and we deserve recognition.

... We came close to achieving our goal,

THEN ... Celebrate! Outline steps needed to reach our goal or acknowledge that we did all we could.

... We achieved part of our goal,

THEN ... Celebrate! Adjust or develop a continuation of our plan.

... We did not accomplish our goal,

THEN ... Celebrate the effort everyone made. Develop a new plan or decide if the goal is still feasible.

... We did not carry through with the plan,

THEN ... Get together and decide if the plan is still something we want to do. If not, move on to another goal.