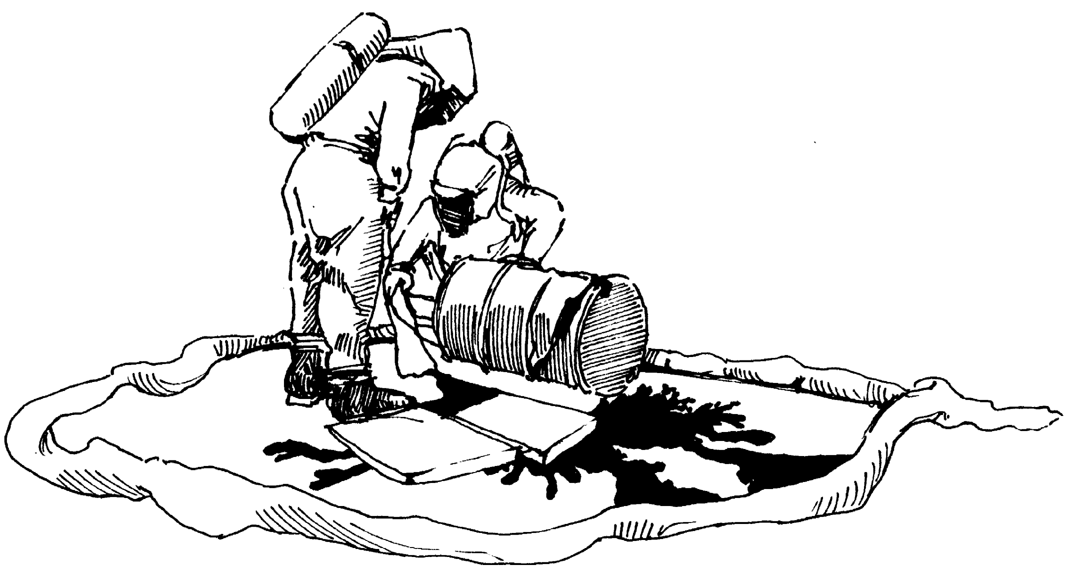

24-Hour Hazardous Waste Participant's Manual

Revised January/2001

TABLE OF CONTENTS

Introduction

The Occupational Safety and Health Administration (OSHA) has written regulations to make sure that workers at hazardous waste sites are properly protected. These regulations require that contractors plan their work carefully, and that they use the right equipment and work methods. A very important part of the OSHA regulation is that workers must be given 24 hours of training off-site and a minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

This Hazardous Waste Awareness Course, developed by the Center to Protect Workers' Rights for the Construction consortium for Hazardous Waste Worker Training, meets all requirements for the 24 hour awareness training. More importantly, it has been designed to meet your needs. The course has been prepared for workers, by workers, and is meant to be taught by experienced tradespeople.

This course will help you to learn about your legal rights and responsibilities, how to recognize and control hazards, how to obtain information about hazardous materials, and how to use and decontaminate respirators and protective clothing. You will also learn about correct work practices, air and medical monitoring, and emergency response.

The CPWR Hazardous Waste Worker Course has been designed to be clear, direct, and to involve you actively in the learning process.

- Learning objectives, found at the beginning of each chapter, tell you what you will be expected to be able to do after you finish the training

- Brief case studies demonstrate the importance of the information and skills taught.

- The information that you need is stated in clear, non-technical language wherever possible. Technical or unfamiliar concepts are carefully explained.

- Additional classroom lectures, demonstrations, and activities help you to be actively involved in the learning process and to become confident in your ability to use what you learn.

- Summaries review key points.

- Your instructors are always available to explain any material that is not clear.

It is CPWR's goal that every trainee leave the twenty four-hour Hazardous Waste Awareness Course with the basic skills, knowledge and confidence that he or she needs to work safely at hazardous waste sites, and that they will be better able to protect themselves on all their jobs. With your active participation, we are confident that we will meet that goal.

ACKNOWLEDGMENTS

This curriculum has been adapted by CPWR based upon work done by the UBC Health & Safety Fund from source materials of the Midwest Consortium for Hazardous Waste Worker Training under grant number U45 ES06184-04 from the National Institute of Environmental Health Sciences.

WARNING

The material was prepared for use by experienced instructors in the training of persons who are or who anticipate being employed at a hazardous waste worksite. Authors of this material have prepared it for the training of this category of workers as of the date specified on the title page. Users are cautioned that the subject is constantly evolving. Therefore, the material may require additions, deletions, or modifications to incorporate the effects of that evolution occurring after the date of this material preparation.

DISCLAIMER

The Occupational Safety and Health Administration (OSHA) rule to help assure worker health and safety at hazardous waste sites requires introductory, general training on basic hazard recognition, use of provided protective equipment, basic hazard control, decontamination procedures, and other relevant standard operating procedures, as well as training at each site. This program is intended to meet the requirements of the introductory, general training. It must be followed by on-site training, during which the specifics of the protective equipment, decontamination methods, and other procedures and information at the site are discussed and practiced. At that time, the elements of the site-specific standard operating procedures are given in detail.

Additional training is necessary to perform many activities. These activities include implementing the emergency response plan, identifying materials using monitoring instruments, selecting protective equipment, and performing advanced control containment or confinement. Additional site-specific training for emergency response must be provided so that you understand how to recognize and respond to alarms at the site and can carry out any role which may be assigned during a response.

For information about further training, consult the training instructor, your company safety and health plan, your company health and safety representative, or your union health and safety representative.

CHAPTER 1: LEGAL RIGHTS & RESPONSIBILITIES

The Occupational Safety and Health Administration (OSHA) is responsible for worker safety and health at hazardous waste sites. Other Federal and state agencies are responsible for protecting the community, environmental, and transportation system from hazardous materials. Your employer must provide a safe and healthful workplace and the necessary protective equipment to reduce exposure to hazardous substances. You are responsible for knowing and following the employer's safety rules.

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After this training, you will be able to:

- ☞ Identify which government agencies are responsible for aspects of safety, health, and environmental protection.
- ☞ Find information you need from OSHA regulations
- ☞ Discuss your health and safety rights on the job.
- ☞ Identify your health and safety responsibilities.

CASE STUDY

A worker at a hazardous waste cleanup site wanted to know more about the "SuperKleen" solvent they were using to take contamination off of walls. He asked a co-worker to get the chemical fact sheet (Material Safety Data Sheet) for "SuperKleen." The co-worker told him, "You do not have to keep MSDSs on hazardous waste sites." Who was right?

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OSHA

The Occupational Safety and Health Act of 1970 (OSHAct) established the Occupational Health and Safety Administration (OSHA) within the Department of Labor. Organized labor worked hard to support the creation of OSHA. OSHA's job is to write and enforce health and safety standards (rules) to protect workers. OSHA regulations apply to all employers regardless of size.

Employer Responsibilities

Your employer must:

- **Provide a safe and Healthy Workplace.**
  The employer must provide a place of employment free from recognized hazards that are causing or are likely to cause death or serious physical harm to employees. This responsibility is commonly referred to as the "general duty clause"[Section 5 (a) (1)] of the OSHAct.

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  Employers must comply with OSHA regulations contained in either the General Industry Standards (29 CFR.1910) or the Construction Industry Standards (29 CFR.1926). If there is a conflict between two standards, the most protective standard must be used and enforced. Remember that all construction standards are applicable on hazardous waste sites.

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You must:

- **Follow your Employer's Safety Rules:**
  Employees must wear provided personal protective equipment and follow the employers safety rules. You cannot be cited or fined by OSHA, but you can be disciplined for violating your employer's safety rules.

- **Bring Safety and Health Concerns to the Attention of your Union or Management:**
  Tell your job steward, foreperson or business agent about health and safety concerns on the job. Section 11 (c) of the OSHAct prohibits disciplining or discriminating against any worker for using their OSHA rights, including filing a complaint. Your union can also help you to use your rights.

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- **File a complaint against your employer**

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  An OSHA compliance officer (inspector) must tell you if you are exposed to an imminent danger (one that could cause death or serious injury now or in the near future). The compliance officer will also ask the employer to stop the dangerous activity. If necessary, a judge can force the employer to stop the work.

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The OSHA Hazardous Waste Operations and Emergency Response standard is designed to safeguard the safety and health of workers at hazardous waste sites and emergency response personnel. It is commonly called HAZWOPER. In the construction standards it is 29 CFR 1926.65 (See Appendix A for the entire standard).

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- exactly what kind of doctor's exams are needed, and when
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Every section of the plan should explain:

- what to do
- where to do it.
- when it needs to be done, and
- who will do it
- how to do it

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OSHA says anyone who works on a hazardous waste site needs special doctor's exams to make sure the chemicals are not making you sick.

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If barrels or drums are moved, a lot of injuries can happen. Metal drums can weigh 400-1000 pounds or more each, depending on what kind of chemicals are in them, so dropping a drum can seriously injure a worker. A few chemicals can explode if they are dropped. Spilled chemicals can mix and start a fire or explosion. Employers have to write a plan for how to handle drums to prevent injuries.

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Workers who are on a site that has been fully characterized or who are on a site for a specific task and are unlikely to be exposed above the Permissible Exposure Limit also require the 24 hour training **PLUS** 1 day of field experience (site specific) under the direct supervision of a trained, experienced supervisor.

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Things can go wrong during a cleanup. There can be a fire or explosion; workers can be poisoned by gases or hit by a forklift; or large amounts of chemicals can spill. The employer has to plan ahead in case there is an emergency and write down and follow the plan.

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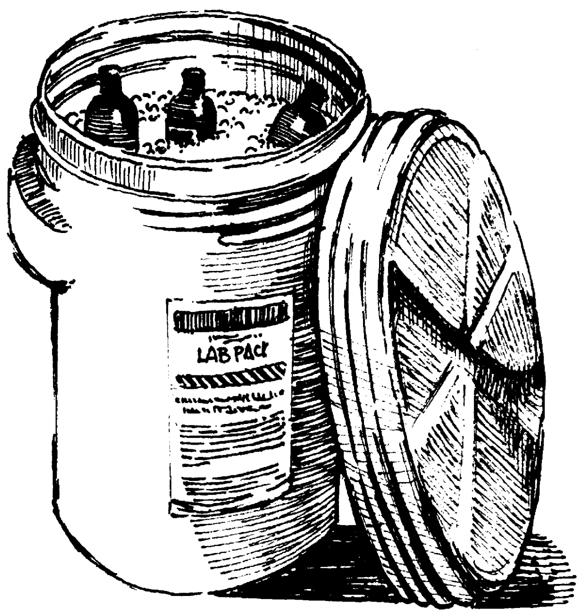
The OSHA Hazard Communication Standard for Construction (1926.59) requires employers to set up a hazard communication (HazCom) program for the products they bring on site. This standard points you to the General Industry (non-construction) standard 1910.1200. The HazCom standard applies to all hazardous materials that are not hazardous wastes. Materials covered by the HazCom program include: drum solvents, vehicle maintenance products, and chemicals used to treat wastes or chemicals for portable toilets. A copy of selected sections of the Hazard Communication Standard can be found in Appendix A of this manual.

Written Hazard Communication Program - 1910.1200 (e)

This program must:

- Be available to employees and their representatives
- Include a complete and current list of the hazardous chemicals in each work area
- Describe the methods used to inform employees about the hazards of non-routine tasks and unlabeled pipes

Labels and Other Forms of Warning - 1910.1200 (f)



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- Hazardous chemicals must be labeled with chemical identity, hazard warnings and name and address of manufacturer
- Employers must ensure that all containers of hazardous chemicals are labeled (except for portable containers used by a single employee)

Material Safety Data Sheets (MSDS) - 1910.1200 (g)

Employers must keep chemical fact sheets called Material Safety Data Sheets (MSDSs) at the work site so that everyone can find out the dangers of the chemicals and how to protect themselves:

- Manufacturers and distributors must forward MSDS to an employer with the first shipment
- Employers must get and keep MSDSs for each hazardous chemical in their workplace
- MSDSs must be filled out completely and accurately
- Copies of MSDSs must be immediately accessible to employees during all shifts

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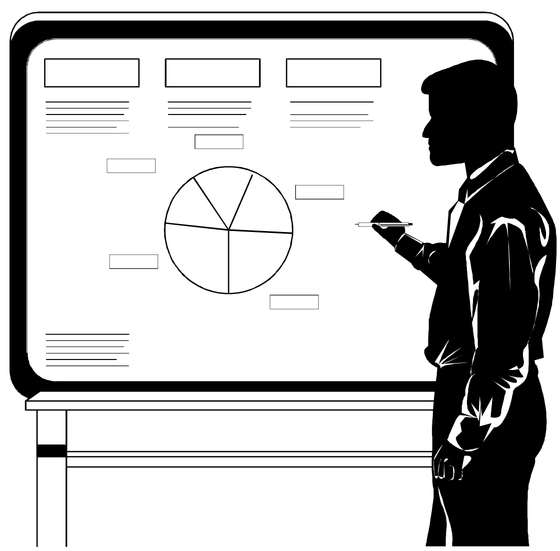
- MSDSs are not required for hazardous wastes found on site, since these are tested and measured before cleanup work starts

Employee Information and Training - 1910.1200 (h)

Employers must train employees on the hazardous chemicals in their work areas.

- At initial assignment and when new hazards are introduced
- Education must include the requirements of the OSHA HazCom Standard
- Employees must be told the location of the employer's written hazard communication program, MSDSs, and hazardous chemical lists.
- Employees must be trained about the hazards of the materials used in their areas and how to recognize exposure
- Employees must be taught how to read information on labels and MSDSs <u>and understand it</u>



Hazardous Materials Legislation

The Resource Conservation and Recovery Act of 1976 (**RCRA**) gave the EPA the authority to control hazardous waste from the "cradle to grave." This includes the generation, transportation, treatment, storage, and disposal (TSD) of hazardous waste. It also mandated that OSHA establish worker safety and health standards, including training.

Other Federal Agencies with Hazardous Materials Responsibilities

OSHA is the most important agency for protecting workers on Superfund sites. The following additional government agencies may be involved in hazardous waste operations:

- **Environmental Protection Agency (EPA)**
  - Protects our air, land, and water from pollution.
  - Regulates the cleanup of hazardous waste sites (Superfund).
  - Requires the testing of chemicals before they are sold and the disposal of hazardous materials.

- **Department of Transportation (DOT)**
  - Regulates the transportation of hazardous materials on land and air.
  - Requires labels, placards, manifests, and shipping containers.

- **United States Coast Guard (USCG)**
  - Regulates the transportation of hazardous material on navigable waters.
  - Involved in cleaning up oil and chemical spills.

- **Nuclear Regulatory Commission (NRC)**
  - Regulates community and worker exposure to radiation hazards.

- **National Institute of Occupational Safety and Health (NIOSH)**
  - Approves respiratory protection equipment
  - Conducts research
  - Publishes recommended workplace exposure limits

- **Department of Energy (DOE)**
  - Responsible for controlling worker and environmental hazards at nuclear weapons sites.

SUMMARY–LEGAL RIGHTS AND RESPONSIBILITIES

The agency in charge of health and safety at work is OSHA--the Occupational Safety and Health Administration. In some states, the U.S. government enforces regulations. In other states, your state government is in charge.

The OSHAct set up both employee and employer rights and responsibilities. A major employer responsibility is to provide a workplace free of recognized safety and health hazards likely to cause serious physical harm. A major employee responsibility is to follow reasonable employer safety rules and to wear personal protective equipment when required.

Two specific OSHA regulations important to hazardous waste workers are:

1 . The Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) (29 CFR 1926.65)--It protects the safety and health of hazardous waste site workers, and includes:
- Safety Plan
  - hazards on site
  - hazwaste cleanup plan/work practices
  - decontamination
  - emergency procedures
  - monitoring
  - personal protective equipment
  - medical surveillance
- Medical exams (medical surveillance)
- Washing up (decontamination)
- New cleanup methods (new technology)
- Moving barrels of waste (drum handling)
- Training for workers and supervisors
- What to do in an emergency (emergency response plan)

2. The Hazard Communication Standard (29 CFR 1910.1200) requires employers to inventory and label products that are hazardous. On a hazardous waste site, only cleanup and other products that are brought on site are covered. The employer must set up an effective, written program for communicating hazards to workers which includes:
- Inventory of chemicals on site
- Labeling containers
- Getting and making available Material Safety Data Sheets
- Employee training
- Keeping records about the program

Finding OSHA Regulations

All Federal Regulations are published in a series of books called the Code of Federal Regulations: CFR for short. The 29th Title (or volume) of the CFR contains all the regulations about labor. Construction safety and health standards are contained in part 1926 of Title 29 and the construction HAZWOPER standard is in section 65 of part 1926. In legal shorthand the standard is referred to as 29 CFR 1926.65. Individual paragraphs are in alphabetical order with sub-paragraphs in numerical order. Smaller divisions are numbered using roman numerals and then capital letters

General industry standards are found in part 1910 (the general industry HAZWOPER standard is at 1910.120. Many important standards, like HAZCOM, are only printed in the general industry standards (1910) but are referred to in the construction standards and therefore apply to construction workplaces.

The box below shows how the system for finding standards works.

Requirements for General Site Workers ***29 CFR 1926.65***		
29	**=**	**OSHA regulations are located in Title 29**
CFR	**=**	**Code of Federal Regulations is the title of the government publication**
1926	**=**	**Part number 1926 covers Construction**
.65	**=**	**Section number 65 covers hazardous waste operations and emergency response**
(e)	**=**	**The paragraph which describes a specific topic such as training**
(3)	**=**	**A sub-paragraph which gives details about the topic such as Initial Training**
(i)	**=**	**A sub-sub paragraph which gives details about the details, such as Initial Training for General Site Workers**
So, 29 CFR 1910.65 (e) (3) (i) covers initial training for general site workers at hazardous waste sites.		

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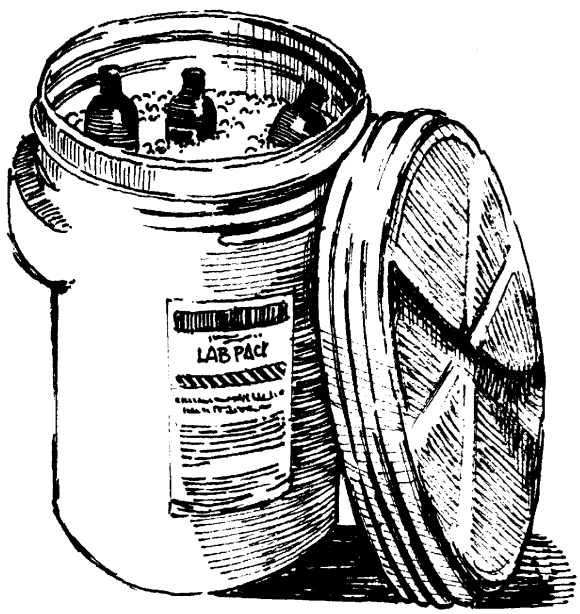

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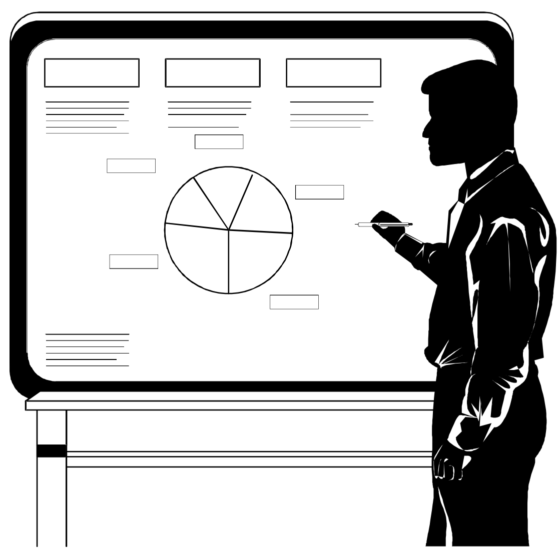
- Employees must be trained about the hazards of the materials used in their areas and how to recognize exposure
- Employees must be taught how to read information on labels and MSDSs <u>and understand it</u>



Hazardous Materials Legislation

The Resource Conservation and Recovery Act of 1976 (**RCRA**) gave the EPA the authority to control hazardous waste from the "cradle to grave." This includes the generation, transportation, treatment, storage, and disposal (TSD) of hazardous waste. It also mandated that OSHA establish worker safety and health standards, including training.

Other Federal Agencies with Hazardous Materials Responsibilities

OSHA is the most important agency for protecting workers on Superfund sites. The following additional government agencies may be involved in hazardous waste operations:

■ **Environmental Protection Agency (EPA)**
- Protects our air, land, and water from pollution.
- Regulates the cleanup of hazardous waste sites (Superfund).
- Requires the testing of chemicals before they are sold and the disposal of hazardous materials.

■ **Department of Transportation (DOT)**
- Regulates the transportation of hazardous materials on land and air.
- Requires labels, placards, manifests, and shipping containers.

■ **United States Coast Guard (USCG)**
- Regulates the transportation of hazardous material on navigable waters.
- Involved in cleaning up oil and chemical spills.

■ **Nuclear Regulatory Commission (NRC)**
- Regulates community and worker exposure to radiation hazards.

■ **National Institute of Occupational Safety and Health (NIOSH)**
- Approves respiratory protection equipment
- Conducts research
- Publishes recommended workplace exposure limits

■ **Department of Energy (DOE)**
- Responsible for controlling worker and environmental hazards at nuclear weapons sites.

SUMMARY–LEGAL RIGHTS AND RESPONSIBILITIES

The agency in charge of health and safety at work is OSHA--the Occupational Safety and Health Administration. In some states, the U.S. government enforces regulations. In other states, your state government is in charge.

The OSHAct set up both employee and employer rights and responsibilities. A major employer responsibility is to provide a workplace free of recognized safety and health hazards likely to cause serious physical harm. A major employee responsibility is to follow reasonable employer safety rules and to wear personal protective equipment when required.

Two specific OSHA regulations important to hazardous waste workers are:

1 . The Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) (29 CFR 1926.65)--It protects the safety and health of hazardous waste site workers, and includes:
   - Safety Plan
     - hazards on site
     - hazwaste cleanup plan/work practices
     - decontamination
     - emergency procedures
     - monitoring
     - personal protective equipment
     - medical surveillance
   - Medical exams (medical surveillance)
   - Washing up (decontamination)
   - New cleanup methods (new technology)
   - Moving barrels of waste (drum handling)
   - Training for workers and supervisors
   - What to do in an emergency (emergency response plan)

2. The Hazard Communication Standard (29 CFR 1910.1200) requires employers to inventory and label products that are hazardous. On a hazardous waste site, only cleanup and other products that are brought on site are covered. The employer must set up an effective, written program for communicating hazards to workers which includes:
   - Inventory of chemicals on site
   - Labeling containers
   - Getting and making available Material Safety Data Sheets
   - Employee training
   - Keeping records about the program

Finding OSHA Regulations

All Federal Regulations are published in a series of books called the Code of Federal Regulations: CFR for short. The 29th Title (or volume) of the CFR contains all the regulations about labor. Construction safety and health standards are contained in part 1926 of Title 29 and the construction HAZWOPER standard is in section 65 of part 1926. In legal shorthand the standard is referred to as 29 CFR 1926.65. Individual paragraphs are in alphabetical order with sub-paragraphs in numerical order. Smaller divisions are numbered using roman numerals and then capital letters

General industry standards are found in part 1910 (the general industry HAZWOPER standard is at 1910.120. Many important standards, like HAZCOM, are only printed in the general industry standards (1910) but are referred to in the construction standards and therefore apply to construction workplaces.

The box below shows how the system for finding standards works.

Requirements for General Site Workers ***29 CFR 1926.65***		
29	**=**	**OSHA regulations are located in Title 29**
CFR	**=**	**Code of Federal Regulations is the title of the government publication**
1926	**=**	**Part number 1926 covers Construction**
.65	**=**	**Section number 65 covers hazardous waste operations and emergency response**
(e)	**=**	**The paragraph which describes a specific topic such as training**
(3)	**=**	**A sub-paragraph which gives details about the topic such as Initial Training**
(i)	**=**	**A sub-sub paragraph which gives details about the details, such as Initial Training for General Site Workers**
So, 29 CFR 1910.65 (e) (3) (i) covers initial training for general site workers at hazardous waste sites.		

CHAPTER 2: WORKSITE HAZARD RECOGNITION

Chemical, physical and biological hazards are found at hazardous waste sites. You need to know how to recognize hazards and the signs and symptoms of exposure in order to protect yourself, others, and the environment. This chapter includes (1) chemistry, (2) toxicology and health effects, and (3) physical and safety hazards.

Chapter Objectives

After this training, you will be able to:

- ☞ Find information about specific chemicals you are working around.
- ☞ Use the *NIOSH Pocket Guide* and MSDS's to identify dangerous properties of materials.
- ☞ Use that information to protect yourself (for example, knowing what chemicals should not be mixed together).
- ☞ Use measurements taken at work to figure out whether too much of a chemical is getting into the air.
- ☞ Recognize and prevent or avoid safety dangers like heat stroke, falls, electrocutions, or cave-ins.

CASE STUDY

A worker at a hazardous waste cleanup site was combining half-full drums. A "sniffer" test showed that two drums had non-flammable materials, so he poured the chemical from one drum into another. The liquid started to spatter and bubble, then caught on fire. What happened?

The two chemicals combined and gave off so much heat that they did catch on fire. Chemicals that are dangerous to mix are called "incompatible." In this chapter you will learn about compatibility and other dangers of chemicals to prevent this kind of problem.

SECTION I– TOXICOLOGY AND HEALTH EFFECTS

Basic Principles of Toxicology: What Can Poisons Do?

Toxicology is the study of poisons and their effect on the body. What is a toxic response?

- The nausea, dizziness and eye, throat, and airways irritation caused by your first inhaled cigarette was a toxic reaction.
- Slurred speech, dizziness, nausea and vomiting caused by too much alcohol is also a toxic response.
- Difficulty in breathing caused by years of working with concrete that contains crystalline silica is a toxic response.

These are examples of toxic responses; your response to toxic exposure may be immediate or it may not be evident for years.

Acute Health Effects: Damage Now

Acute health effects appear immediately or shortly after (within 72 hours) of exposure.

Chemical	Acute Response
acrolein (tear gas)	irritates eyes, skin, mucous membrane, difficulty breathing (delayed excess fluid in lungs)
sulfuric acid,	skin, eye, and throat burning
nitric acid	eyes, skin, mucous membrane, irritation and pulmonary edema (fluid in lungs)
phosgene (carbonyl chloride)	pulmonary edema 24 hrs. after exposure, death

Acute health effects may disappear as soon as the exposure is removed or the damage may be permanent.

Chronic Health Effects: Damage Days, Months, or Years Later

Chronic health effects are generally the result of long-term, usually low-level exposure to a chemical. For example, long-term exposure to asbestos can cause emphysema, lung cancer, and other cancers, but it does not scratch your throat or give you any early warning that it is dangerous.

You may not notice any effects from chronic exposure to a chemical for many years. You generally do not feel the damage as it is being done.

Exposure to:	Chronic Response
asbestos	asbestosis, lung cancer, other cancer (mesothelioma)
benzene	central nervous system effects, leukemia, anemia, liver damage
formaldehyde	nasal and lung cancer, skin sensitization, asthma
fume from sulfuric and/ or nitric acid	eye, throat, and airways irritation; enamel erosion of front teeth
solvents	liver, kidney, skin damage, central nervous system effects

Routes of Entry: How Can it Enter My Body?

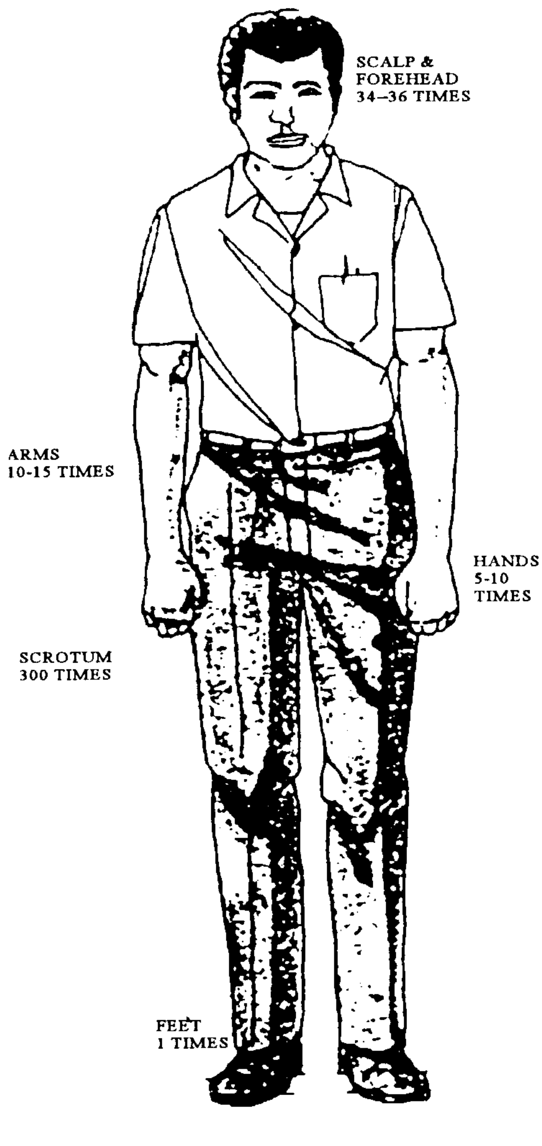
Chemicals get into the body by three main routes of entry: inhalation, ingestion and skin contact/absorption. Chemicals can also enter the body through other routes, like injection. Most chemicals can enter the body by more than one route of entry. The toxicity of a chemical is influenced by how it gets into your body. For example, vitamin D can be *acutely toxic* by ingestion but is not acutely or chronically toxic by skin contact/absorption. Generally the lungs offer the least resistance to a chemical entering your body. Metallic mercury is not acutely toxic by inhalation or ingestion, but metallic mercury is very toxic if *chronically* inhaled or ingested

Inhalation: Breathing In

Inhalation is the major way that toxic substances get into your body. The chemicals and particles you inhale end up in the lungs or cross into the blood stream along with oxygen. Larger particles do not get into the lungs because they are trapped by hair-like cilia in the nose and upper airways. Only very small particles are breathed into the lungs. Smoking can damage the cilia, allowing dust and chemicals to enter and remain in the lungs.

Absorption: Soaking Through the Skin

The skin is a major route of exposure. Many chemicals (for example, solvents and liquid insecticides) cross through intact skin into the bloodstream. If the skin is irritated, damaged, or punctured, absorption is increased. Many chemicals break down the fat of the skin or cause allergic or irritant dermatitis.



Ingestion: Swallowing

Chemicals can be swallowed when you eat, drink, or smoke. Toxic particles are also ingested when you swallow the mucus collected by the cilia. Do not eat, drink, smoke, or put on ChapStick or other cosmetics in a contaminated area. Never bring cigarettes or cosmetics into contaminated areas.

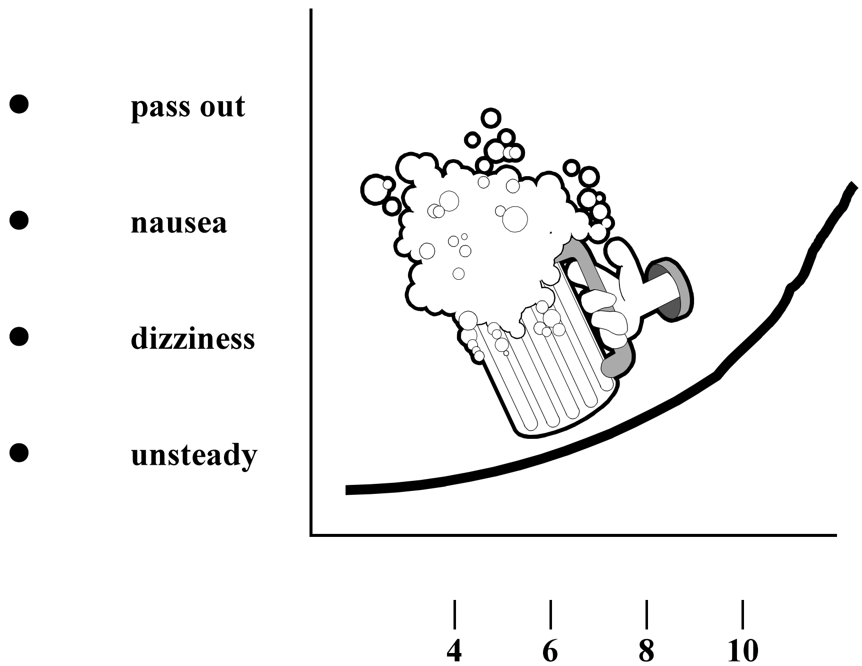
Injection

Injection is a minor route of entry caused by a contaminated tool, compressed air/gas line, fall, or sharp object.

Different areas of the body absorb chemicals at different rates. This graphic compares the chemical absorption rate of some parts of the body to the absorption rate of the feet.

The Body's Response to Exposure

Dose Response: a higher dose means a greater response by the body.



alcohol
increasing number of drinks in 2 hours

Several factors influence each person's dose response to alcohol, and the same is true with respect to chemicals at worksites.

Factors that affect an individual's response to a toxic chemical.

- **Body weight**
- **Occupation**
- **Physical and health condition**
- **Gender**
- **Exposure to other chemicals**
- **Heredity**
- **Age**
- **Lifestyle (smoking, nutritional status)**

How does your body react?

Head: dizziness, headache

Ears: ringing, temporary deafness, hearing loss

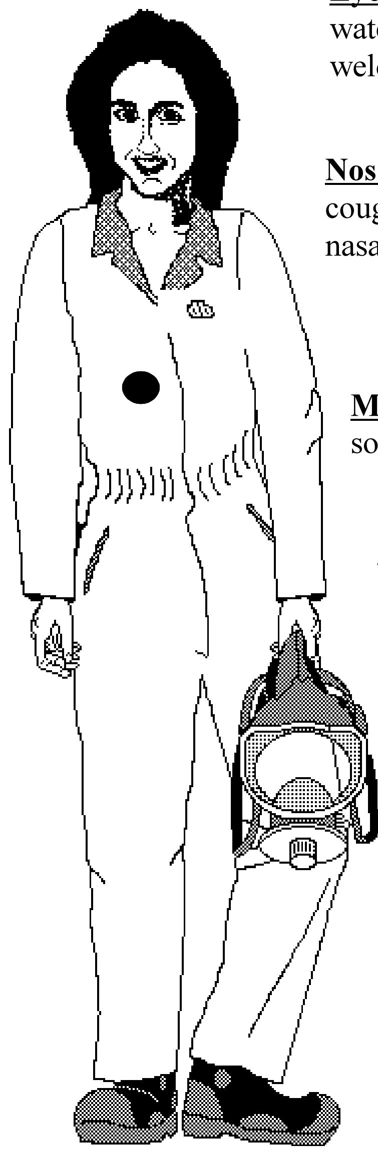
Teeth & Gums : corrosion of tooth enamel, blue gums

Chest & Lungs : wheezing, congestion, shortness of breath on mild exercise, flu-like symptoms
(e.g., “metal fume fever”)

Stomach & Intestines: vomiting, diarrhea

Joints:
tendinitis, inflammation

Skin: redness, dryness, itching, ulcers, skin cancer



Eyes: redness, irritation, watering, grainy feeling, welder’s flash

Nose & Throat: sneezing, coughing, sore throat, nasal cancer

Muscles & Back:
soreness, strain

Reproductive System:
miscarriage, irregularities in menstruation, damage to fetus or chromosomes, sterility

Nervous System: stress nervousness, irritability, sleeplessness, tremors, speech changes

adapted from the International Metal Worker’s Union

Health Effects:
What affects your body?

Head: solvent, heat exhaustion, eye strain, noise, gases, vapor

Ears: excessive noise

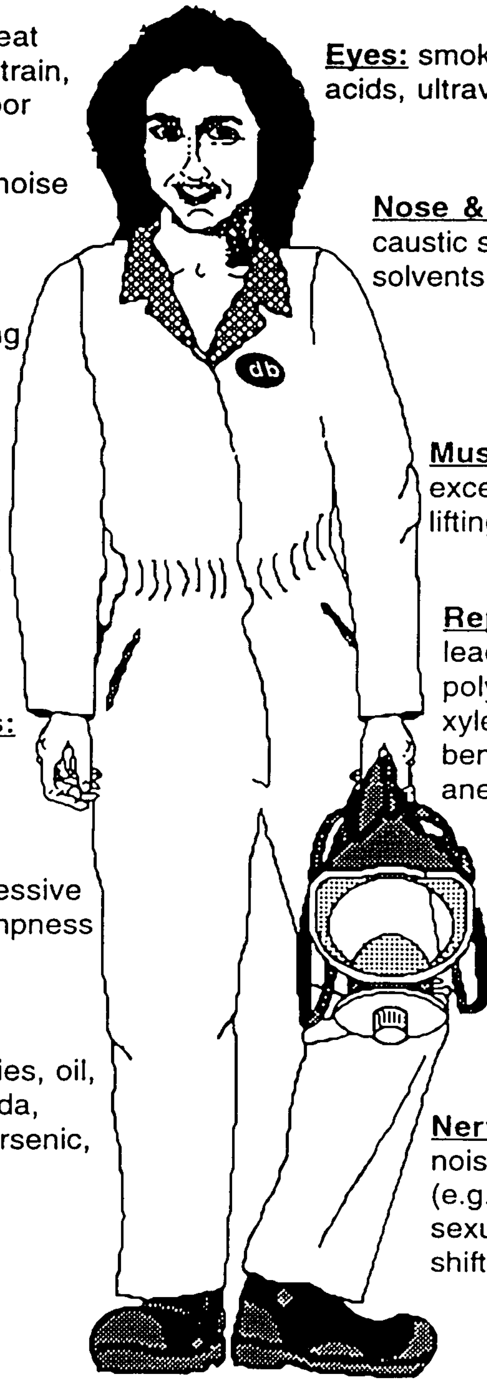
Teeth & Gums: acid fumes, cellulose, acetate production, lead poisoning

Chest & Lungs: cotton dust, TDI, detergent enzymes, beryllium solvents, long-term exposure to mineral dust (e.g., asbestos), metal oxides from welding, gases, vapors

Stomach & Intestines: vapors, fumes, ingested substances

Bones & Joints: excessive vibration, constant dampness

Skin: solvents, epoxies, oil, fiberglass, caustic soda, nickel, mineral oils, arsenic, pitch, tar, radiation



Eyes: smoke, grease, fumes, acids, ultraviolet radiation

Nose & Throat: ammonia, caustic soda, dusts, resins, solvents, acid fumes, smoke

Muscles & Back: excessive or improper lifting, bending, vibration

Reproductive System: lead, pesticides, radiation, polystyrene production, xylene, some solvents, benzene, lead, mercury, anesthetic gas

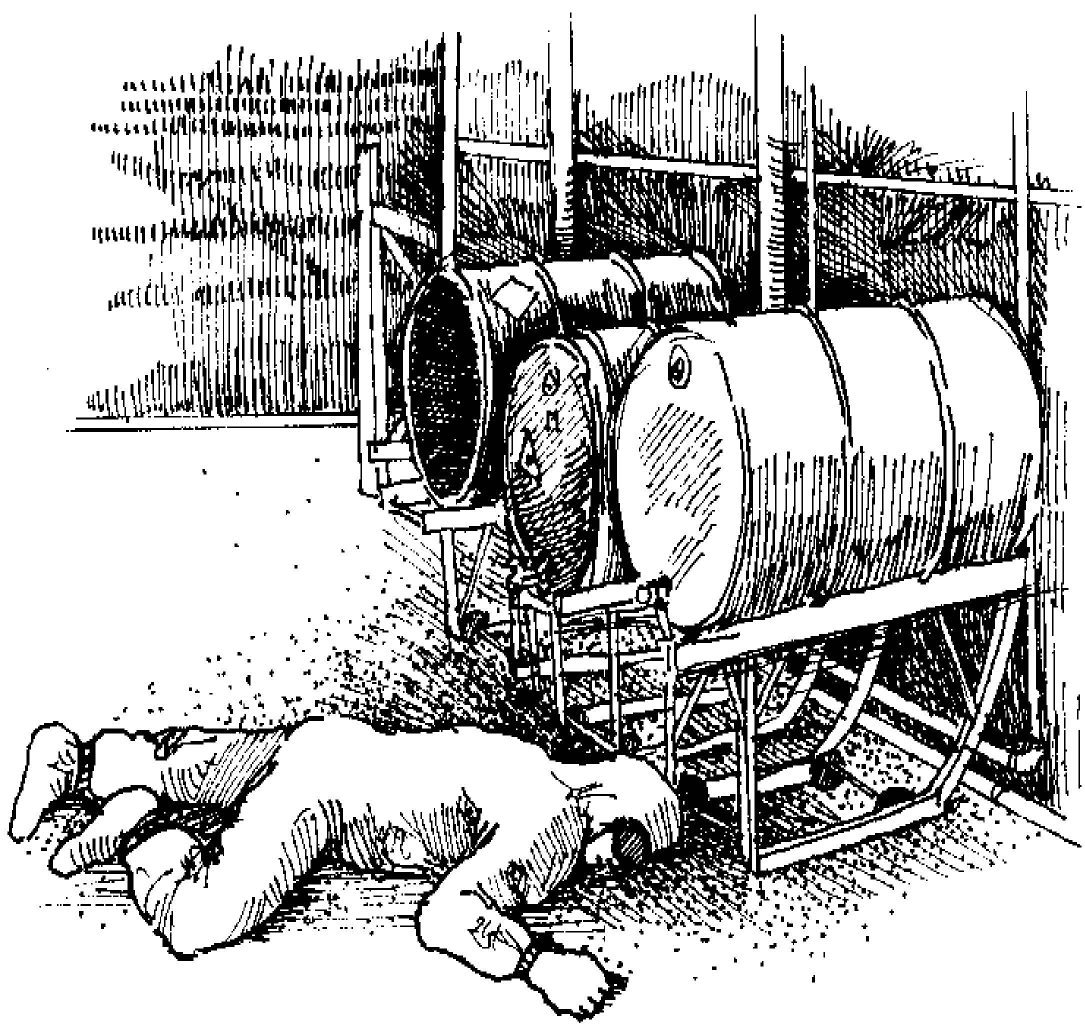
Nervous System: noise, metal poisoning (e.g., lead, mercury), sexual harassment, shift work

adapted from the International Metal Worker's Union

Asphyxiants: Can it Suffocate You?

There are two kinds of asphyxiants (chemicals that can suffocate) which can cause unconsciousness and death. Simple asphyxiants take the place of (displace) oxygen in the air. Carbon dioxide, ethane, helium, hydrogen, methane, and nitrogen are simple asphyxiants.

Chemical asphyxiants prevent the uptake of oxygen by your body. Carbon monoxide, hydrogen cyanide, and hydrogen sulfide are chemical asphyxiants. At high levels, all asphyxiants can cause collapse, unconsciousness, and death.



WHAT HAPPENS TO YOUR BODY IF YOU DO NOT HAVE ENOUGH OXYGEN?

Amount of Oxygen	Results
20.9 %	You breathe this normally
19.5%	Minimum, for safe entry
16%	Dizzy and confused
14%	Difficulty breathing
6%	Breathing stops; you may die

Courtesy of LOHP

Irritants: Can it Irritate my Skin or Lungs?

An irritant causes inflammation of the skin or respiratory system by direct contact.

- Respiratory irritants cause injury to the nose, mouth, throat and lungs. Materials that are 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).

  Chemicals which affect both the upper and lower lung are chlorine and ozone.

  Respiratory 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 cause death.

- Skin irritants can cause contact dermatitis- redness, itching and drying of the skin. Organic solvents and detergents are examples of skin irritants. Very corrosive agents, such as chromic acid, can cause skin ulcers and destroy tissue.

Allergic Sensitizer

After repeated exposures to certain chemicals, some people become allergic and develop a reaction to even small exposures of those chemicals. Allergic sensitizers generally affect the skin and respiratory tract. The symptoms are often the same as those caused by irritants. Examples of such symptoms include dermatitis or asthma. As with irritants, the response can be very serious, and may even cause death. Sensitizers include: isocyanates, formaldehydes, phenol resins, epoxy resins, chromium, and nickel.

Systemic Toxins: Poisons That Move Through the Body

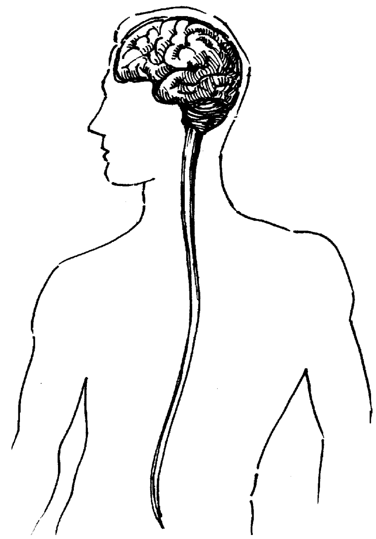
Systemic toxins affect body systems that are removed from the body part of original contact.

Blood System Toxins— damage blood cells or interfere with blood cell formation. Examples include benzene, methylene chloride, arsine, phosphorus, and naphthalene.

Nervous System (Neuro) Toxins— damage the nervous system. 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) Toxins— cause liver damage, including jaundice and liver enlargement. Examples include alcohols, carbon tetrachloride, and nitrosamines.

Kidney (Nephro) Toxins— These toxins damage the kidney. Examples include halogenated hydrocarbons and heavy metals.



Central Nervous System

Reproductive Cell Toxins— damage the reproductive cells (egg and sperm) or interfere with their formation. Examples include DBCP, lead, cadmium, cellosolves, and vinyl chloride.

Carcinogens, Teratogens, and Mutagens: Cancer and Birth Defects

Carcinogens—Carcinogens cause cancer. Cancer is the uncontrolled growth of malignant (harmful) cells at any site in the body. Cancer can take 20 to 30 years to develop. Carcinogens include vinyl chloride, asbestos, methylene chloride, and toluene-2, 4-diisocyanate.

Teratogens—Teratogens cause birth defects in the developing fetus. Examples include thalidomide, anesthetic gases, methyl mercury, and ionizing radiation. Many teratogens can affect the fetus even before the woman knows she is pregnant.

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. Examples of mutagens include ethylene oxide (a sterilizing chemical used in hospitals), benzene, hydrazine, and ionizing radiation. Most mutagens should be assumed to be carcinogens

How Chemicals are Measured

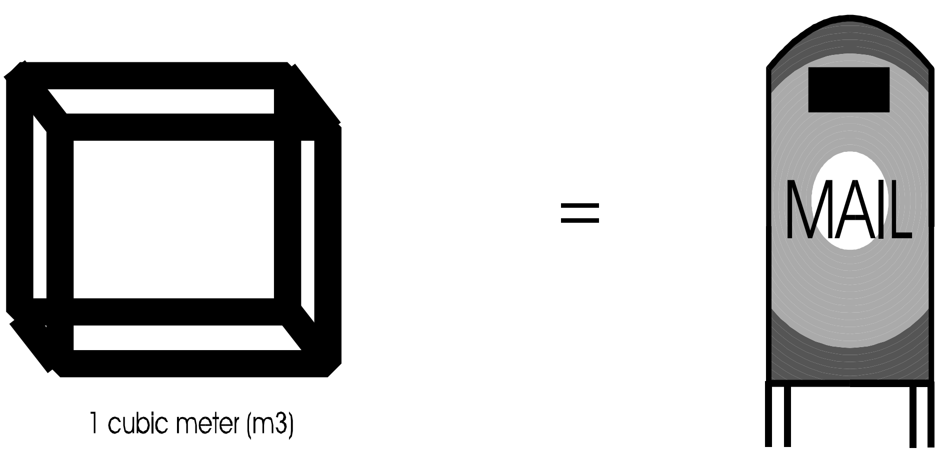
Concentration is the amount of a substance in a given unit of another material (usually air). Concentration of gases and vapors is usually measured in parts per million (ppm). Concentration of particulates (including dusts and metal fumes) is usually measured in weight per volume of air. Concentration is different from weight because 5 milligrams of arsenic is different from 5 milligrams of arsenic in every cubic meter of air.

- mg/m^3—Milligrams of substance in each cubic meter of air. (A cubic meter = 39" x 39" x 39") Most commonly used for measuring concentrations of dusts, metal fumes, or other particles in the air. For example one crushed aspirin in a cubic meter of air is 325 mg/m^3.

- ppm—parts per million. Mainly used for measuring the concentration of a gas or vapor in a million parts of air.

- mg/kg—Milligrams of substance per kilogram of body weight. It is used generally to measure toxic chemicals used in animal experiments. A kilogram is a metric unit weighing about 2.2 U.S. pounds.

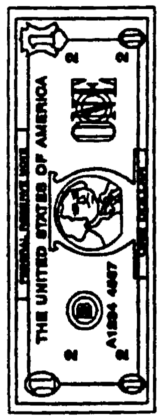
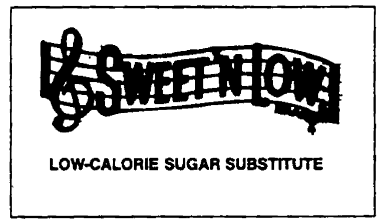
  The *NIOSH Pocket Guide* lists a conversion factor from ppm into mg/m^3 for many chemicals.



Volume of air inside a
public mailbox

1 meter = 39 inches

MEASURING WEIGHT

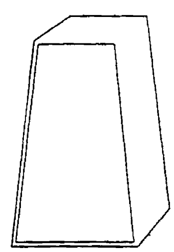
1 gram (g) =  **or** 

Weight of 1 packet of Sweet 'N Low

Weight of a dollar bill

1 thousand millgrams (mg) = 1 gram

1 million micrograms (ug) = 1 gram

454 grams = 

1 pound

Measuring Volume

1 part per million (ppm)

is

equivalent to

1 inch in 16 miles

or

1 drop in 18 gallons

1% = 10,000 ppm

Exposure Limits: <u>How Much Is Legal?</u>

Enforceable exposure limits are set by OSHA. NIOSH and non-governmental agencies (such as the American Conference of Governmental Industrial Hygienists [ACGIH]) also establish limits, but these recommendations are not legally enforceable.

Permissible Exposure Limits (PELs)
Permissible Exposure Limits (PELs) are legal exposure levels set by OSHA. Employers must keep exposures below the PELs.

Threshold Limit Values (TLVs)
Threshold Limit Values are recommended exposure limits, ACGIH, a private, non-governmental agency. TLVs, which are not legally enforceable, are reviewed and updated annually.

Recommended Exposure Levels (RELs)
Recommended Exposure Levels (RELs) are set by NIOSH. RELs are not legally enforceable. RELs are usually the most protective of human health.

Most PELs, and TLVs, are determined as average exposures over an 8-hour work shift. RELs are set for 10-hour days (since many of us work 4 10s), so they protect us more. Some PELs, TLVs, and RELs have a "skin" description, which means that the material is readily absorbed through the skin.

Short-Term Exposure Limits (STELs)
The STEL is a maximum average concentration to which a person may be exposed for a short period of time, usually 15 minutes. It is legally enforceable if set by OSHA. (NIOSH and ACGIH also have recommended STELs.)

Ceiling Limits
The ceiling limit is an exposure level which must not be exceeded at any time. It is legally enforceable if set by OSHA.

<u>Your Exposure Limits: Important Points to Remember</u>
Most OSHA Permissible Exposure Limits (PELs), and ACGIH Threshold Limit Values (TLVs) are 8-hour averages for exposure.

- STELs are set for very few compounds
- STELs and Ceiling limits are for acute exposure
- You can submit a written request to your employer for exposure monitoring results under the OSHA Standard on Access to Employee Exposure and Medical Records (29CFR1910.1020)

Exposure Limits - Time Weighted Averages (TWA's)

Most PELs are 8-hour Time Weighted Averages (TWA). TWAs, expressed as either mg/m3 or ppm, average exposure over an 8-hour work shift.

There are also shorter TWAs. Short Term Exposure Limits (STELs) are TWAs that average exposure over a 15-minute period.

How a Time-Weighted Average is Calculated
You are exposed to acetone at 80 ppm for 6 hours and 60 ppm for 2 hours. What is your average exposure for an 8-hour shift ? $$TWA = \frac{(80 \text{ ppm} \times 6 \text{ hours}) + (60 \text{ ppm} \times 2\text{-hours})}{(6 \text{ hrs.} + 2 \text{ hrs})}$$ $$TWA = \frac{(480 + 120) \text{ ppm} \times \text{hours}}{8 \text{ hours}}$$ $$TWA = 75 \text{ ppm}$$ The OSHA Permissible Exposure Limit (PEL) for acetone is 1,000 ppm. The PEL has not been exceeded.

Combining Exposures

Measurements for different chemicals must be added up, especially if the chemicals are related. For example, if you work on a hazardous waste site cleaning up acetone, xylene, and toluene, it is important to combine your exposure to all three. This example shows how to combine exposures to chemicals that have similar effects. Air monitoring shows that acetone levels are at 500 ppm, xylene levels are at 50 ppm, and toluene levels are at 100 ppm. To determine if controls must be used the exposures are combined:

$$\frac{\text{TWA acetone}}{\text{PEL acetone}} + \frac{\text{TWA xylene}}{\text{PEL xylene}} + \frac{\text{TWA toluene}}{\text{PEL toluene}} = \text{Combined Exposure}$$

$$\frac{500 \text{ ppm}}{1000 \text{ ppm}} + \frac{50 \text{ ppm}}{100\text{ppm}} + \frac{100\text{ppm}}{200 \text{ ppm}} =$$

$$\frac{1}{2} + \frac{1}{2} + \frac{1}{2} = 1\tfrac{1}{2} \text{ X Combined PEL}$$

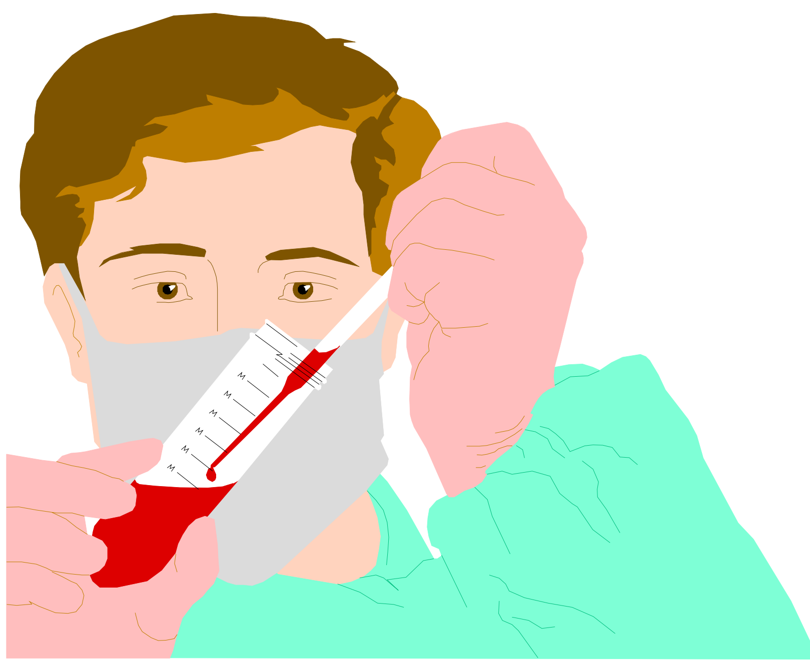
The combined PEL number must be less than 1 to be within allowed limits. In this example the combined exposures are at 1 ½ times the combined PEL. Controls must be used.

Biological Monitoring

Some exposures can be measured in blood, urine, or exhaled breath.

Examples include:

Substance	How Measured
Lead	Blood
Carbon monoxide	Breath
n-hexane	Breath, urine
Parathion (pesticide)	Urine
Perchloroethylene	Blood, urine, breath



SUMMARY:
TOXICOLOGY AND HEALTH EFFECTS

A high concentration (dose) of a toxic chemical for a short period of time is called an acute exposure. Acute exposures can be very dangerous to your health now. A low concentration of a toxic chemical over a long period of time is called a chronic exposure. Some chronic exposures cause cancer, permanent nerve or brain damage, lung, liver, or kidney disease.

Some toxic chemicals only harm you at the point of contact with your body (skin, eyes, and lungs)--this is called a local effect. Other toxic chemicals enter your bloodstream and spread to all the tissues and organs in the body. They can cause systemic effects.

Chemicals can get into the body by absorption (soaking through the skin), inhalation (breathing in), and ingestion (getting in your mouth when you eat or smoke). These are called routes of entry.

When the concentration of a toxic chemical increases, the toxic response in the body increases. This is called the dose response for the chemical. Each worker has his or her own dose response to a chemical.

Chemicals can be dangerous to both people and the environment. You should be able to identify these hazards and protect yourself.

Solvents irritate the skin, eyes, nose, throat and lungs. When solvents get into the blood, the brain and nerves are affected. Long-term exposure to many solvents can cause damage to the liver and kidneys.

Acids and caustics (alkalies or bases) damage the skin, eyes, and airways. These concentrated corrosive chemicals burn the skin and the eyes.

Some chemicals and radiation can damage the blueprint (DNA) of the cell--these are called mutagens. Chemicals (like asbestos) and radiation that cause cancer after many years are called carcinogens. Some chemicals and radiation can also cause birth defects--these are called teratogens. Some chemicals can cause other problems with the ability to have a child for both men and women, like infertility, changes in hormones, and menstrual problems. Birth defects and retardation in children may also occur when a pregnant woman is exposed.

When lead, mercury, or other heavy metals get into the body in high concentrations, the brain and nerves are affected. Even at low levels lead can cause anemia. Cadmium and uranium are poisons that can cause kidney damage and lung cancer.

SECTION II–
PHYSICAL HAZARDS

What Will we clean up?

The Most Common Chemicals

TOP 20 HAZARDOUS SUBSTANCES ATSDR/EPA PRIORITY LIST FOR 1999

Chemical Name

. Arsenic
. Lead
. Mercury
. Vinyl Chloride
. Benzene
. Polychlorinated Biphenyls (PCBs)
. Cadmium
. Benzo(a)pyrene
. Polycyclic Aromatic Hydrocarbons
. Benzo(b)fluoranthene
. Chloroform
. DDT, P'P'-
. Aroclor 1260
. Aroclor 1254
. Trichloroethylene
. Chromium (+6)
. Dibenz[a,h]anthracene
. Dieldrin
. Hexachlorobutadiene
. DDE, P,P'

Beryllium is also common on hazardous waste sites.

*Source: ATSDR Web Site
http://www.atsdr.cdc.gov/cxcx3.html

Chemical formulas

All chemicals are made up of atoms that can come together to form molecules. There are only ninety-two types of atoms, or elements, that appear in nature. Each element has a chemical symbol. For example, carbon's symbol is C and oxygen's symbol is O. Chemical formulas describe what atoms and molecules are made of. Each formula lists the symbols of the atoms in the molecule and the number of those atoms. For example, carbon monoxide (CO) has one carbon atom and one oxygen atom; carbon dioxide ($C0_2$) has one carbon atom and two oxygen atoms.

Atoms commonly found in hazardous chemicals or at hazardous sites

Non-metals		**Metals**		**Inert Gases**	
Carbon	C	Sodium	Na	Helium	He
Oxygen	O	Potassium	K	Neon	Ne
Hydrogen	H	Aluminum	Al	Argon	Ar
Nitrogen	N	Iron	Fe	Radon	Rn*
Sulfur	S	Mercury	Hg		
Phosphorous	P	Chromium	Cr		
Chlorine	Cl	Nickle	Ni		
Fluorine	F	Lead	Pb		
		Uranium	U*		
		Plutonium	Pu*		
		Silica	Si		

* Radioactive elements

Organic (Carbon) Chemical molecules — Nearly all chemicals that contain carbon are organic molecules. Do not confuse organic chemicals (many are poisonous) with organic vegetables (no pesticides). Many solvents are organic chemicals. Petroleum, coal, oils, vegetation and all animals are made of organic chemical compounds. Some organic compounds are:

Benzene (C_6H_6)	Carbon tetrachloride (CCl_4)
Chloroform ($CHCl_3$)	Ethyl alcohol (CH_3CH_2OH)
Glucose ($C_6H_{12}O_6$)	Carbon monoxide (CO)

Inorganic Chemical molecules — Inorganic chemicals generally **do not contain a carbon atom.** Examples include:

Hydrochloric acid (HCl)	Ammonia (NH_3)
Sulfuric Acid (H_2SO_4)	Sodium Chloride—table salt (NaCl)
Water (H_2O)	Sodium Hydroxide (NaOH)
Silica (SiO_2)	

Chemical and Physical Properties: How do Chemicals Act?

How chemicals act depends upon their physical and chemical properties. Understanding how chemicals behave can help you anticipate the hazards.

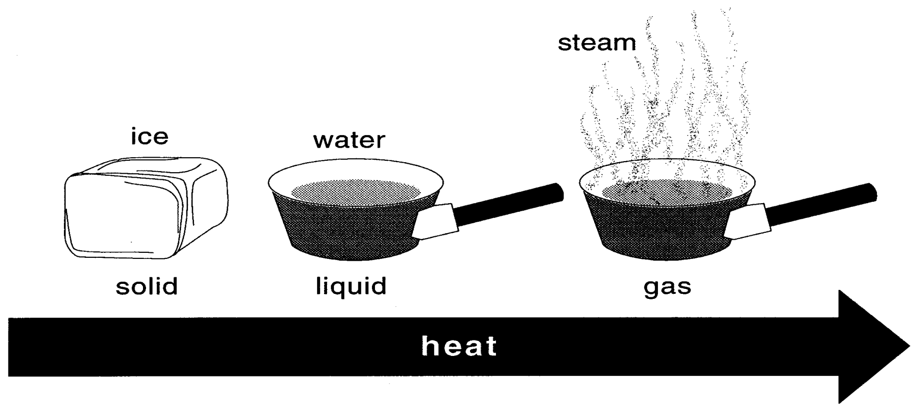
The following properties of chemicals are explained below:

- **Melting point**
- **Boiling point**
- **Corrosiveness**
- **P^H**
- **Flash point**
- **Oxidizer**
- **Hazardous Breakdown Products**
- **Solubility in water**
- **Specific gravity**
- **Vapor density**
- **Explosive limits**
- **Incompatibility**
- **Shock sensitivity**

States of Matter: Solid, Liquid or Gas?

Gases are much more dangerous than liquids, which are more dangerous than solids. So it is important to know what form a chemical usually takes. Chemicals can exist in three states: solid, liquid, or gas/vapor. For example, when lead is a solid, it can't harm you unless you grind it into small particles and inhale it or swallow it. If heated, lead will turn into a liquid which can burn you. If heated more, lead will turn into a fume and is inhaled easily. The chemical state affects how hazardous it is to your health. Benzene, an organic solvent, is liquid when stored at room temperature in a closed container. If the container is opened, benzene begins to evaporate into the air. This vapor can be easily breathed in, and some chemicals get into your body more easily this way.

States of Matter



Melting (Freezing) Point: How Warm Before it Melts?

Definition: Temperature where a solid becomes a liquid or gas.

Examples: Ice left at room temperature changes to a liquid (water).
Dry ice (CO_2) changes to gas.

Boiling Point: How Hot Before It Boils?

Definition: The temperature where a liquid changes into a vapor or gas.

Examples:

PCB	617-691 ºF
Water:	212°F (100°C)
Acetone:	133°F
Chlorine:	-29°F

Importance: If you know the melting and boiling points you can figure out the form a compound will be in at the temperature you are working in.

Reactive Properties:

Knowing the reactive properties of chemicals can help you understand if some things you are working around are dangerous to your skin and eyes or can start a fire.

Corrosive: Can it Burn My Skin?

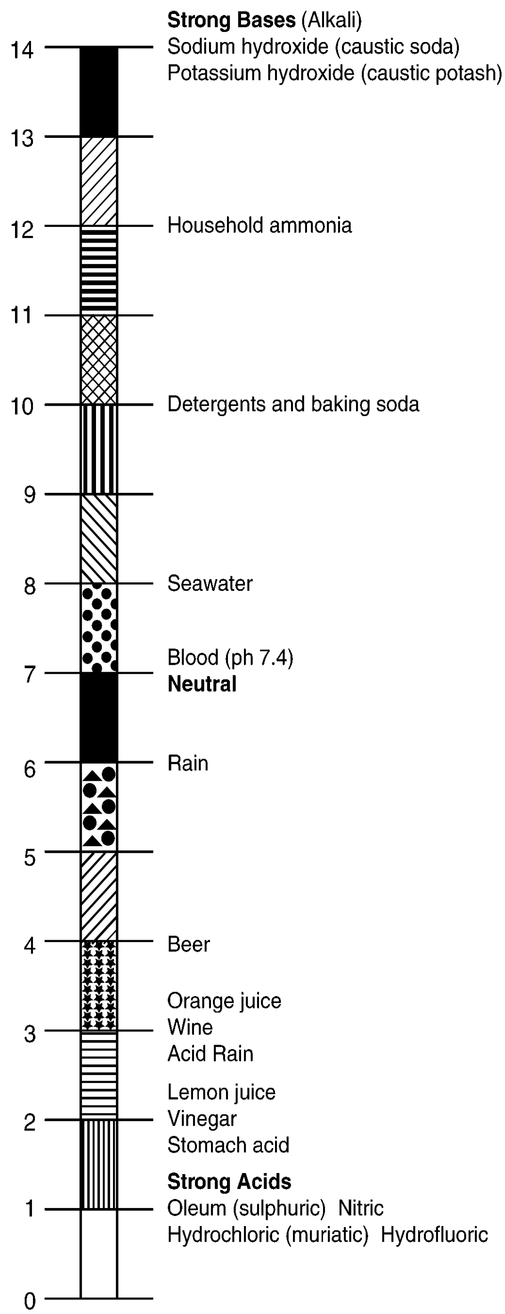
Definition: A compound which can damage skin, eyes, other tissues, metal, and other solids. For example, strong acids (low pH) and bases (high pH) are corrosive.

Examples:

Corrosive Acids	Corrosive Bases
Sulfuric acid (oleum)	Sodium hydroxide
Nitric acid	Lime
Hydrochloric muriatic acid	Lye
Hydrofluoric acid	Caustic soda

Importance: Corrosives are immediate health hazards and must be stored in glass or special plastics.

pH: How Strong Is an Acid?



Definition: **pH is used to determine if a substance is an acid or a base. A pH of 1 is very acidic; a pH of 14 is very alkaline. A pH of 7 is neutral– neither acid nor base. A change in pH of one unit (for example, from 3 to 4) represents a 10-fold change in acidity or alkalinity.**

Importance: **Compounds with high and low pH values will cause burns, irritate eyes, nose and lungs. Wastes with a pH of less than 2 or greater than 12 are legally defined as hazardous.**

Flash Point (Fl. P.): How Warm Before A Liquid Can Burn?

Definition: The lowest temperature at which a liquid will give off enough vapor for the vapors to burn if there is a source of ignition. Liquids do not burn, vapors burn!

Examples:

Acetone	0°F	Flammable
Methyl ethyl ketone	16°F	Flammable
Toluene	40°F	Flammable
Gasoline	45°F	Flammable
Turpentine	95 °F	Flammable
Stoddard solvent	110°F	Combustible
Cresol	187 °F	Combustible

Importance:

- The flash point is used to classify the relative fire hazards of liquids.
- The flash points of combustible liquids are between 100° to 200° F
- The flash points of flammable liquids are below 100°F
- Flammable chemicals can burn at lower temperatures than combustible ones, so they are more dangerous.

Oxidizer: Can it start a fire?

Definition: Chemical that can start or promote burning in other materials.

Examples:

Perchloric acid	Ozone
Hydrogen peroxide	Household bleach
Peroxides	Chlorine

Importance: Oxidizers can react chemically with fuels and can start fires or explosions. Store oxidizers away from flammables and combustibles.

Hazardous Breakdown Product

Some materials that do not burn may release hazardous materials in a fire or even in a welding arc.

Examples: Chlorinated hydrocarbons produce phosgene (mustard gas)
PCBs produce a soot containing the powerful carcinogens dibenzofurans and dibenzodioxins

How will a chemical act in the air or water?

Knowing a material's chemical properties can help you to understand where it is most likely to go in the air and water. This information is important in determining where to do air monitoring and deciding how to protect the environment.

Solubility: Will it Dissolve in Water?

Definition: The amount of a compound that mixes with a known volume of water.

Examples:

Acetone	100
Methylene chloride	2
Toluene	.07
PCB	Insoluble

Importance: Soluble compounds mix with water. If a liquid that is not soluble spills into a waterway, it will either float to the top or sink to the bottom. A chemical's solubility helps determine how to clean up wastes.

Specific Gravity (SG): Will a Liquid Float on Water or Sink?

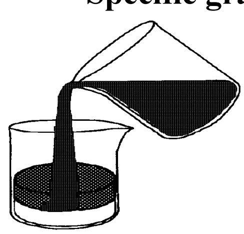
Definition: Weight of a liquid compared with water (water =1). If specific gravity is less than one, the chemical tends to float. If the SG is greater than one, the chemical tends to sink. But if the water is moving, chemicals will mix.

Examples:

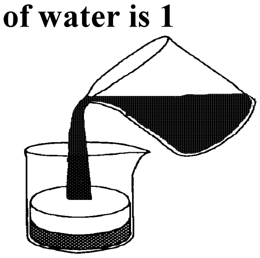
Toluene	0.87
Methylene chloride	1.33
PCB	1.39

Importance: Tells you where a chemical spilled in a waterway is likely to be found (floating on the surface or sunk down to the bottom). Helps determine clean-up methods (like pillows or booms on the surface).

Specific gravity of water is 1



specific gravity less than 1 (floats)



specific gravity more than 1 (sinks)

Vapor Density (VD): Does a Gas or vapor Tend to Rise or Sink in Air

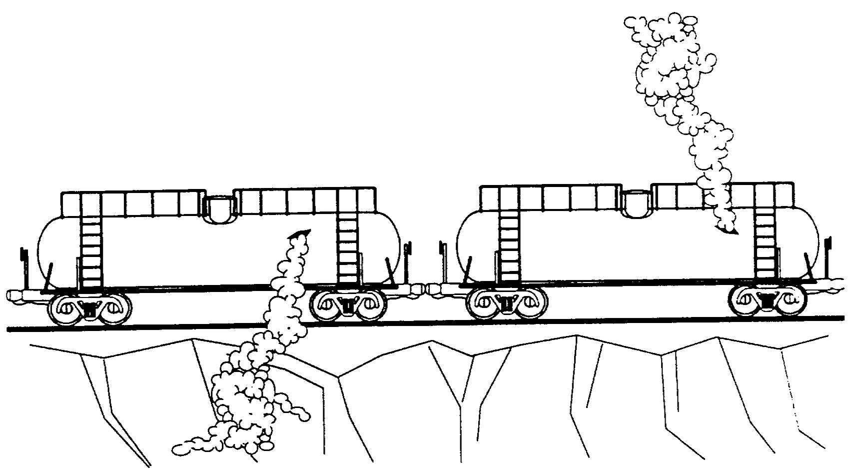
Definition: Weight of a vapor or gas compared to an equal volume of air (air = 1). If greater than 1.0, the vapor or gas is heavier than air and tends to concentrate in low places. If less than 1.0, the vapor or gas tends to rise. But if the air is moving, chemicals will mix.

Examples:

Ammonia	0.59
Ethylene	0.98
Hydrogen sulfide	1.19
Methylene chloride	2.90
Gasoline	4.40
Trichloroethylene	4.50

Importance: Tells you where to expect and monitor for released vapors. Heavy vapors will tend to collect in low lying areas. Any air movement will mix vapors – do not assume that any area is safe based on vapor density.

vapor density of air is 1



vapor density more than 1 (tends to sink) **vapor density less than 1 (tends to rise)**

Hint: If you do not know the vapor density of a chemical, look up its molecular weight (MW) in the *NIOSH Pocket Guide*. If the MW is more than 29 (the molecular weight of air) its vapor is heavier than air. If the MW is less than 29, the chemical is lighter than air.

Vapor Pressure (VP): How Fast Will a Liquid Release Vapors?

Definition: Tells us how easily a liquid releases vapor into the air. The higher the VP, the faster a liquid will become a vapor. Vapor Pressure is measured in millimeters of mercury (mmHg). One Atmosphere of pressure (1 ATM) equals 760 mmHg. Any chemical with a VP of 760 mmHg or more will be a gas at room temperature.

Some chemicals release a large amount of vapor at room temperature. Some require more heat. All liquids release some vapor all of the time. The boiling point is the temperature where the vapor pressure of the liquid gets as high as atmospheric pressure, and a lot more vapor is released. A chemical with a high boiling point will have a low vapor pressure--it needs more heat to become a vapor.

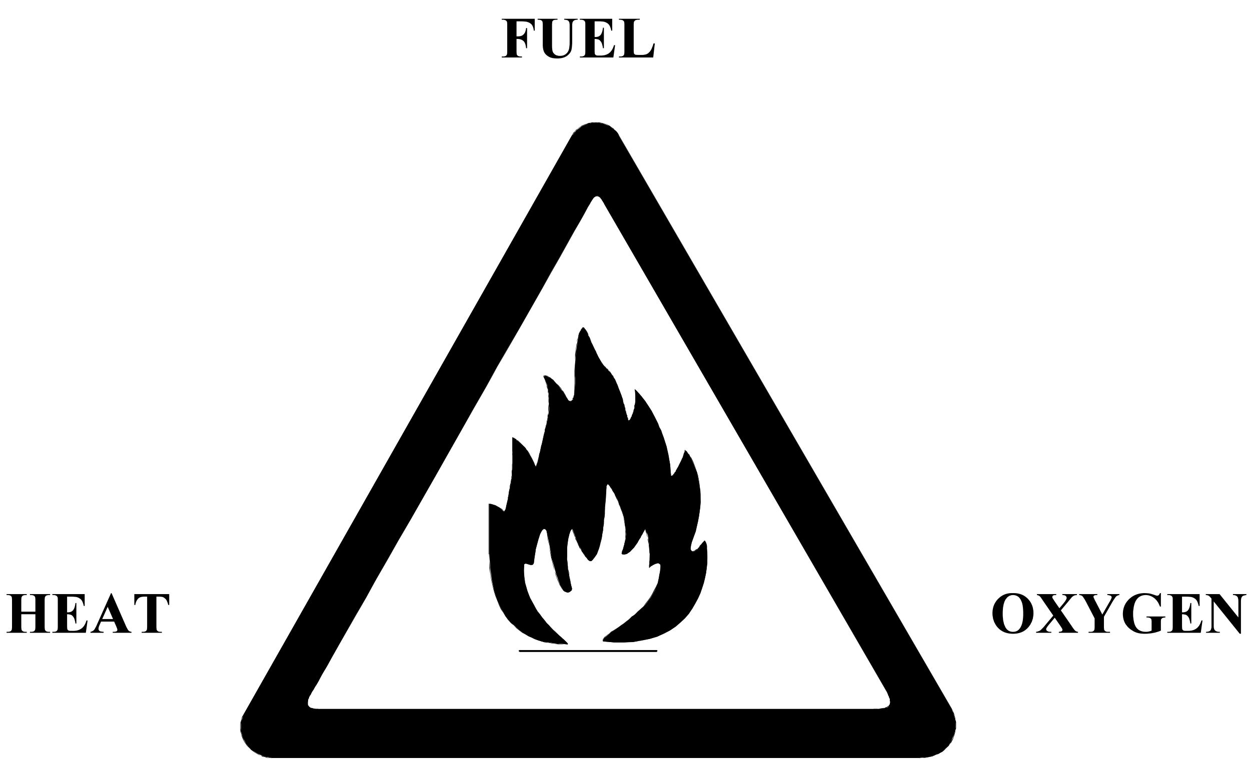
Examples:

	VP(mmHg) at 68 F°	BP (F°)
Chlorine	**>760**	**-29**
Methylene Chloride	**350**	**104**
Acetone	**180**	**133**
Trichloroethylene	**58**	**189**
Water	**24**	**212**
Xylene	**9**	**269**
PCB	**.001**	**691**

Importance: **Chemicals with high vapor pressure enter the air quickly and can be more easily inhaled. Also, a high vapor pressure in a sealed container is more likely to explode as the temperature rises.**

FLAMMABLE CHEMICALS-- THE FIRE TRIANGLE: FUEL, OXYGEN, AND IGNITION SOURCE

For a fire to burn, there must be three things: fuel, oxygen, and an ignition source or spark. Even if you have fuel and enough oxygen, without an ignition source there is no fire. Likewise, with enough fuel and an ignition source, but not enough oxygen, there is no fire. These three items make up the **fire triangle**.



To Put Out A Fire, You Must
Remove One Of The Three Elements

FLAMMABLE VAPORS--EXPLOSIVE LIMITS

Definitions: **Lower Explosive Limit (LEL)** is the lowest concentration (% in air) of a substance which will burn if ignited. Concentrations below the LEL are "too lean" to ignite.

Upper Explosive Limit (UEL) is the maximum concentration (% in air) of a substance which will burn if ignited. Concentrations above the UEL are "too rich" to ignite.

Explosive Range is the concentration of a substance in air between the LEL and UEL. In this range, the substance will readily ignite.

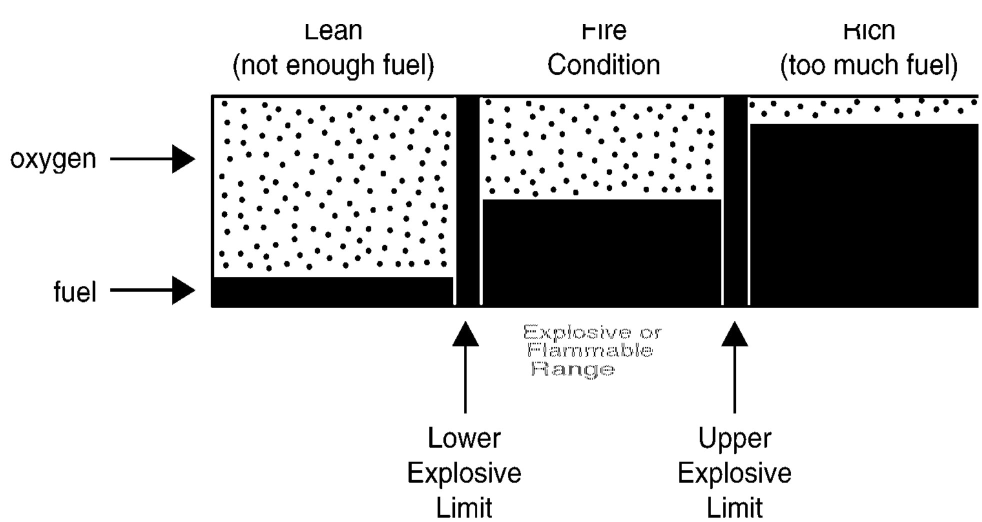
Importance:

1) If the concentration of a flammable vapor or gas is greater than 10% of the LEL, evacuate the area.

- Concentrations above the UEL are not "Safe".

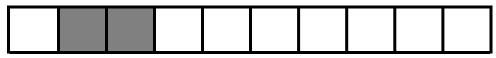
- Concentrations above the UEL can quickly drop into the explosive range by the mixing of air. Do not enter or stay in an area that is above 10% of the LEL.

The concentration of flammable gases can change rapidly, so constant air monitoring is essential.



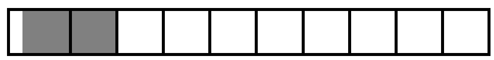
Flammable Ranges Vary Widely

Ammonia (refrigerant)

0%  100%

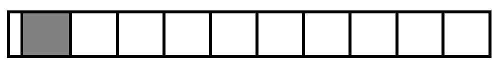
LEL 16% UEL 25%

Acetone (solvent)

0%  100%

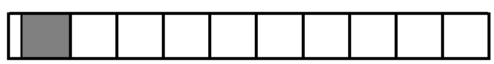
LEL 2.6% UEL 12.8%

Benzene (solvent) also causes cancer at much lower levels

0%  100%

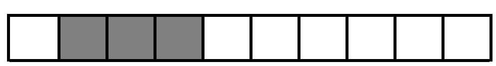
LEL 1.3% UEL 7.1%

Gasoline (fuel)

0%  100%

LEL 1.4% UEL 7.6%

Methyl Alcohol (solvent)

0%  100%

LEL 7% UEL 36%

Ethylene Oxide (disinfectant) also causes cancer at much lower levels

0%  100%%

LEL 3% UEL 100%

Incompatible Chemicals: <u>What If I Mix These Two?</u>

Incompatible chemicals react violently when they come in contact with each other. Reactions of incompatible materials may result in:

- fire
- explosion
- toxic gas release

When strong acids and alkalies (bases) are mixed, heat and spattering occur and can damage eyes and skin. Acids added to cyanides produce hydrogen cyanide gas, which can cause death.

Incompatible chemicals must be stored away from each other and prevented from coming into contact. The containers may leak or rupture. Water-reactive chemicals can create heat, spattering and toxic fumes upon contact with water.

Examples of water-reactive compounds are:	
■ Oxides, hydroxides, and hydrides, of: Lithium Sodium Potassium	■ Halogens: Fluorine Iodine Chlorine Bromine
■ Strong Acids: Sulfuric acid (oleum) Hydrochloric acid Hydrofluoric acid Nitric acid	■ Strong Bases: Sodium hydroxide (lye) Potassium hydroxide Lime

Strong Oxidizers Such As:	React Violently With:
Chromic acid	Acetaldehyde
Chromic anhydride	Acetonitrile
Sodium peroxide	Acrylonitrile
Nitric acid	Benzene
Dry bleaches	Butyl alcohol
Disinfectants	Carbon disulfide
Chlorates	Cresol
Bromates	Cyanides
Nitrates	2,4-D
Peroxides	DDT

Do not Store These Chemicals near Each Other.

A further listing of incompatible chemicals is found in Appendix C to this manual.

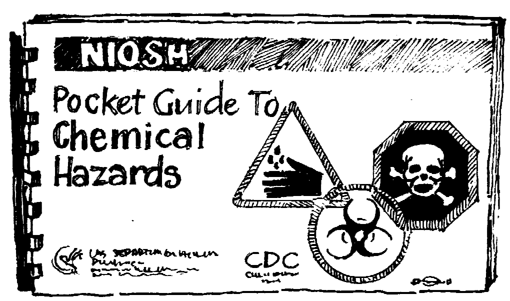
Shock-Sensitive Chemicals: **<u>Will it Explode if I Drop it?</u>**

Definition: Some chemicals such as **picric acid** and **perchloric acid** become unstable over time and will explode if moved.

Importance: Do not handle bulging drums or containers if crystals have formed around the lids. Explosion containment devices and blast shields will be needed to handle these chemicals. OSHA requirements for shock-sensitive chemicals are in **1910.120 (j) (5) and 1926.65 (j) (5).**

<u>The *NIOSH Pocket Guide*</u>

Where Can I Look up This Information?



The *NIOSH Pocket Guide to Chemical Hazards* is an important source of information on the hazards of about 700 chemicals in use today.

Appendix C contains detailed information on how to use the *NIOSH Pocket Guide to Chemical Hazards*.

SUMMARY: CHEMISTRY

Chemical reactions can cause harm to people and the environment by:

- releasing toxic gases
- putting out large amounts of heat
- causing a fire or explosion

Chemical terms used to describe the chemical and physical properties of substances help you anticipate the hazards that may be present.

Knowing the <u>upper and lower explosive limits</u> helps you figure out if the atmosphere could explode. If the concentration of a flammable vapor or gas is greater than 10% of the LEL, the area should be evacuated.

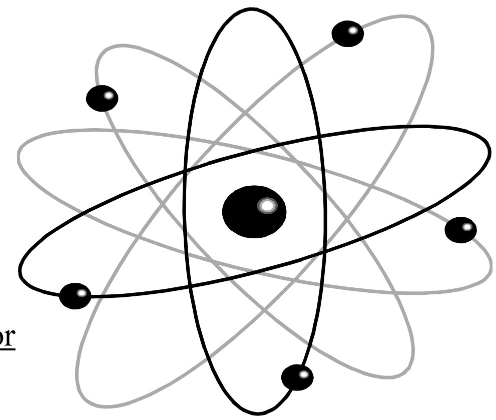
The <u>fire triangle</u> shows the three things necessary for a fire to burn:

- fuel (can be solid, liquid, or a flammable vapor)
- heat (spark or ignition source)
- oxygen in the air

It is very important for you to know which chemicals are <u>incompatible</u> chemicals for your own safety. You can consult the *NIOSH Pocket Guide to Chemical Hazards* to identify chemicals which react violently with water, oxidizers, degreasing solvents, alkalies (bases), and acids.

Radioactivity

Three forms of radioactivity, alpha, beta, and gamma, are capable of causing serious health effects including reproductive and developmental problems, cancer, and death. The degree of damage depends upon the dose and type of radioactivity.



Alpha radiation particles are large and do not travel far (about 3 inches in air). They can be stopped or pushed away by material as thin as a sheet of paper or your outermost layer of skin. If taken into the body, alpha particles are an extreme health hazard.

Alpha radiation:

- damages the body if swallowed (ingested) or breathed in (inhaled)
- requires respiratory protection
- includes radon, uranium, polonium and plutonium

Beta radiation particles are small and travel farther than alpha particles (about 10 feet in air). They can penetrate more deeply into the body. Beta particles will travel through clothes but are somewhat pushed away by plastic.

Beta radiation:

- damages the body if swallowed (ingested), inhaled or allowed to penetrate the skin
- can result in skin burns or even skin cancer
- includes radioactive phosphorus and radioactive carbon

Gamma radiation can pass deep into the body and damage inner organs. It takes a thick lead or concrete shield to stop penetration of gamma rays.

Gamma radiation:

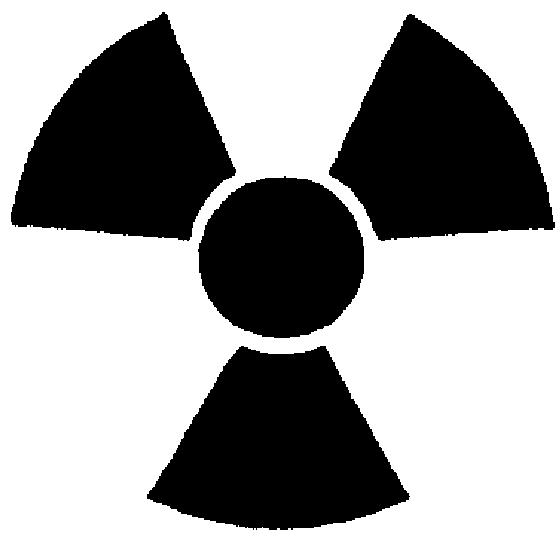
- can deeply penetrate the body
- can result in cancer, burns, and, with massive exposure, death
- includes X-rays and radioactive cobalt

Radiological Postings: Signs

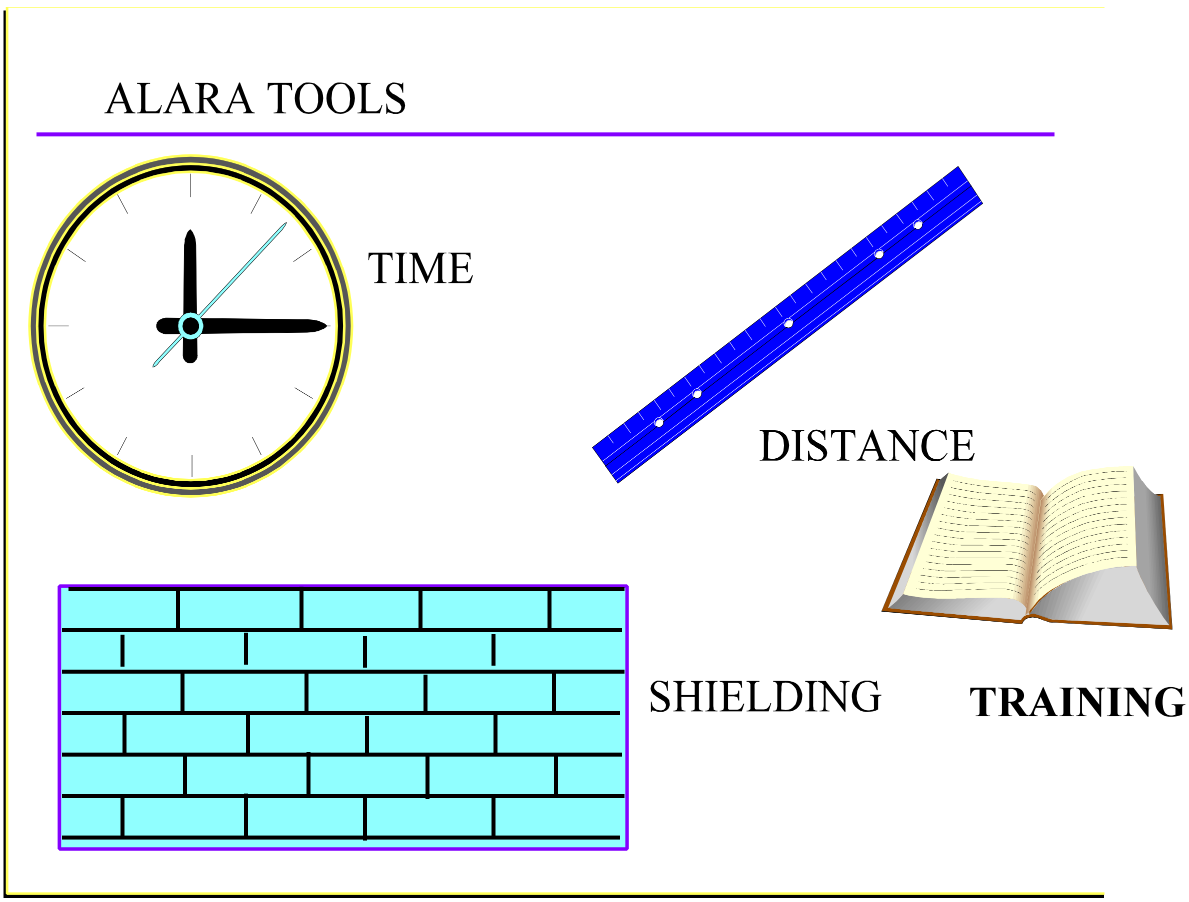
Radiological postings are used to alert personnel to the presence of radiation and radioactive materials.

Areas controlled for radiological purpose will be designated with a magenta (or black) standard three-bladed radiological warning symbol on a yellow background.

- Entrance points to radiation areas must have signs (or equivalent) stating the entry requirements, such as "Personnel Dosimeters, Radiation Work Permit RWP, and Respirator Required." Remember, conditions can change quickly so do not assume the sign is the same as the one you saw before



For Protection From Radiation: ALARA (As Low As Reasonably Achievable)



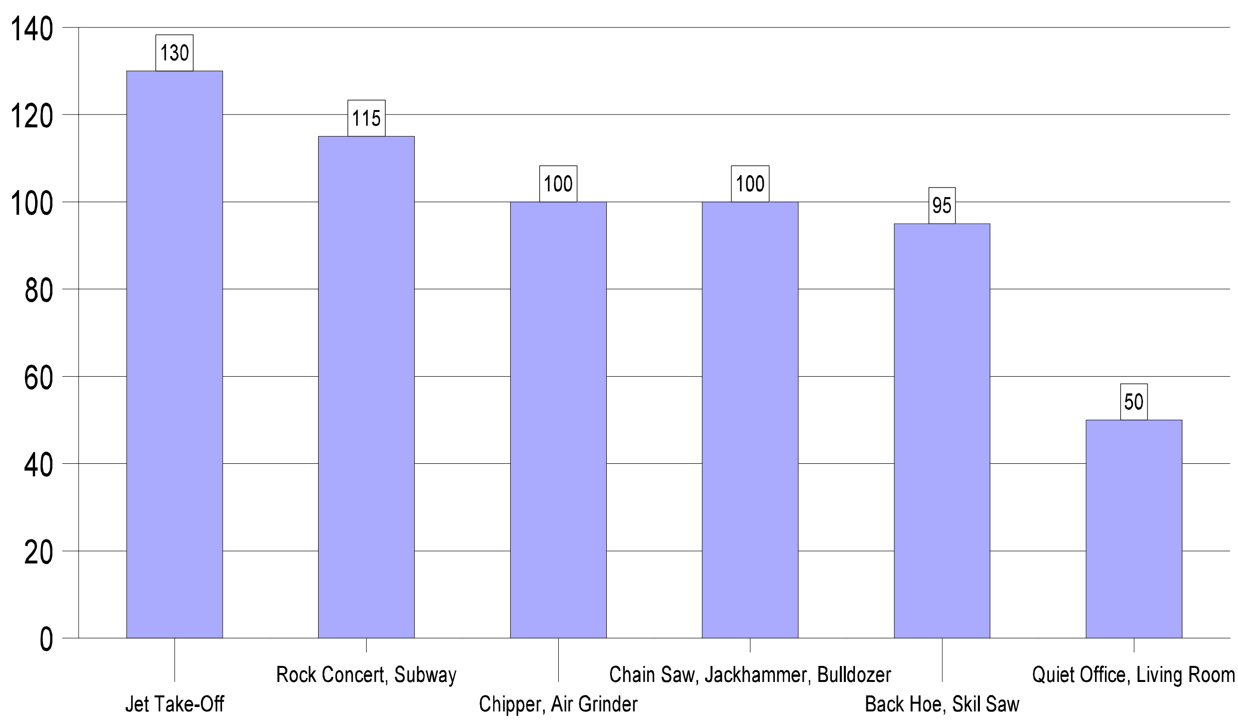
- **Minimize exposure**. Keep your exposure time as short as possible.
- **Maintain distance**. Keep as far away as possible from the radiation source.
- **Use protective barriers** or shielding, to keep the radiation away from your body.
- **Training.** Know how to deal with exposures

Permanent Hearing Damage--Noise

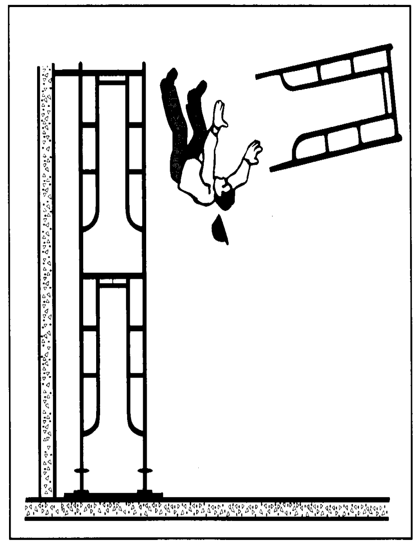
Imagine if you could not hear your child speak to you. Or hear the phone ring. Repeated exposure to excessive noise can cause permanent hearing loss and is a primary cause of hearing disorders. High-volume sound is also linked to high blood pressure, stress, insomnia, anxiety, headaches, and ulcers. Although the harmful effects of noise vary among individuals, **noise levels above 85 to 90 decibels are considered dangerous**, even though the OSHA standard is 90 dB. Building trades workers are at high risk for hearing damage from workplace noise. A 1995 survey of carpenters showed nearly 70% had permanent hearing loss.

- The decibel scale is not a "normal" scale. 88 dB is twice as powerful as 85 dB. (Every increase of 3 dB **doubles** the noise level).
- A 90 dB sound is ten times as powerful as an 80 dB sound
- A 115 dB sound is more than 300 times as powerful as a 90 dB sound

How Loud is Loud?--Decibel Levels for Various Noises



Slips, Trips, and Falls



Falls are the leading cause of death among construction workers. Each year 10,000 construction workers are injured by falls.

In 1994, 36% of deaths from falls were from scaffolding. Of those fatalities, 47% were caused by faulty equipment. OSHA's new scaffolding safety standard, Subpart L of 1926, mandates training for scaffold erectors and users. Fall protection is required for workers on scaffolding more than 10 feet above a lower level.

Slips and trips are caused mainly by bad housekeeping. Slippery surfaces, poor lighting, and weather conditions also contribute to slip /trip hazards. Slips and trips may sound minor but they do cause enormous back and other musculoskeletal injuries. A clean worksite prevents injuries and increases productivity.

Struck-By Hazards

Being struck by a vehicle, construction equipment or material is a leading cause of injuries for construction workers. Personal protective equipment can limit your vision and hearing and create a sense of isolation. To prevent struck-by injuries:

- pay close attention to all activities around you
- watch out for others
- listen for vehicle back-up alarms
- watch for improperly stacked drums
- do not use damaged pallets

Steam

Ruptured steam lines can cause severe burns. Steam can also react with other materials**.** Chemicals which give off toxic clouds may look like steam. If you hear a loud steady, banging, (called a "steam hammer"), get out of the area **immediately**.

Sprains and Strains: Fitting Work to the Worker/Ergonomics

Lifting, bending, repetitive work and awkward postures can, over time, damage the muscles, tendons, nerves and blood vessels. Ergonomics, the study of the relationship between the work and the worker, is covered in Chapter 6, Work Practices.

SUMMARY:
PHYSICAL AND SAFETY HAZARDS

Some dangers on a hazardous waste site will be new to you--they are caused by chemicals. Some hazards are common on construction sites.

Health hazards from heat and cold may be present at the work site. You need to understand the factors that make heat stress more likely, as well as the symptoms to watch out for and first aid if it develops.

All kinds of radiation (alpha, beta, and gamma) may pose serious health hazards as well. Minimizing exposure, maintaining distance, and using protective barriers *will* be necessary.

Common causes of injury at sites are slips, trips, and falls, often resulting from improper ladder use. Check the condition of the ladder and use and follow safe recommended procedures when using them.

Also be aware of possible injury from:

- moving equipment or vehicles that may strike you,
- steam from ruptured lines that may cause severe burns, and
- noise levels that may get in the way of hearing or cause permanent damage.

CHAPTER 3: INFORMATION SOURCES

There are several different systems used to identify hazardous materials. Identification information is included on labels fixed to small containers (drums, packages, boxes) and placards fixed to large containers (trailers, rail cars, tanks).

Chapter Objectives

After this training, you will be able to:

☞ Use DOT symbols and NFPA labels to identify and rate the hazards of shipped and packaged materials.

☞ Use an MSDS to answer specific questions about:
-a product's manufacturer or importer
-what hazardous chemicals it contains
-details of the safety and health hazards of the product
-what protective measures need to be taken when working with it

CASE STUDY
Construction workers were doing major renovations to a waste water treatment plant. A truck delivering to the plant sprang a leak of a choking gas. The driver was knocked out. The truck had this sign on it:

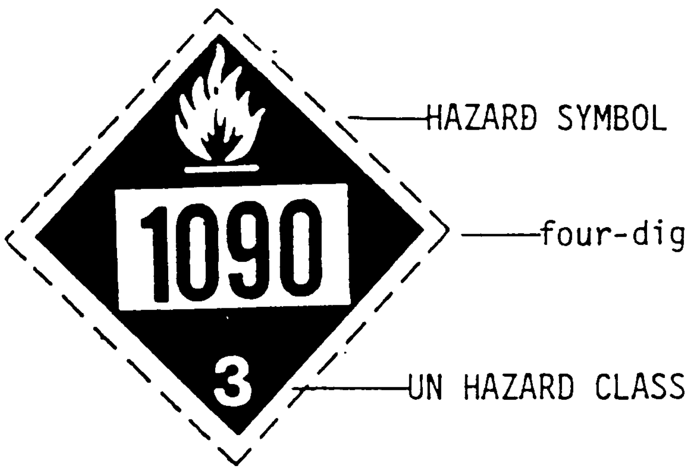
Workers on the scene did not know what was leaking from the truck. What was it?

The truck was carrying chlorine gas, which burns the lungs. Firefighters looked up the number "1017" in a book called the ***DOT Emergency Response Guidebook*** *to find out what the chemical was. In this chapter you will learn how to use the* ***DOT Emergency Response Guidebook*** *and some other places to look up information about chemicals to prevent this kind of problem.*

Department of Transportation (DOT) System Placards and Labels

DOT labels and placards are diamond-shaped and use numbers, symbols and colors to warn about hazards.

Some labels and placards identify specific chemicals, like this one for acetone.



Identifies a specific chemical

Others labels have the hazard symbol and UN hazard class number but name only the hazard instead of a specific chemical.

Hazard Symbol ____________

Hazard Class Name ____________

____

Hazard Class Number

The DOT specifies both colors and symbols to represent classes of hazards.

COLORS

Color	Hazard
orange	explosive
red	flammable
green	non-flammable
yellow	oxidizer/organic peroxides
white	poisonous
white/red vertical stripes	flammable solid
white top with black bottom	corrosive
yellow top with white bottom	radioactive
blue	dangerous when wet
white top with red bottom	spontaneously combustible

SYMBOLS

Symbol	Hazard
bursting ball	explosive
flame	flammable/ combustible
skull and crossbones	poisonous
circle with flame	oxidizing material
cylinder	non-flammable, but container could explode in fire
propeller	radioactive

The **one-digit** number at the **bottom** is the UN (United Nations) Hazard Class.

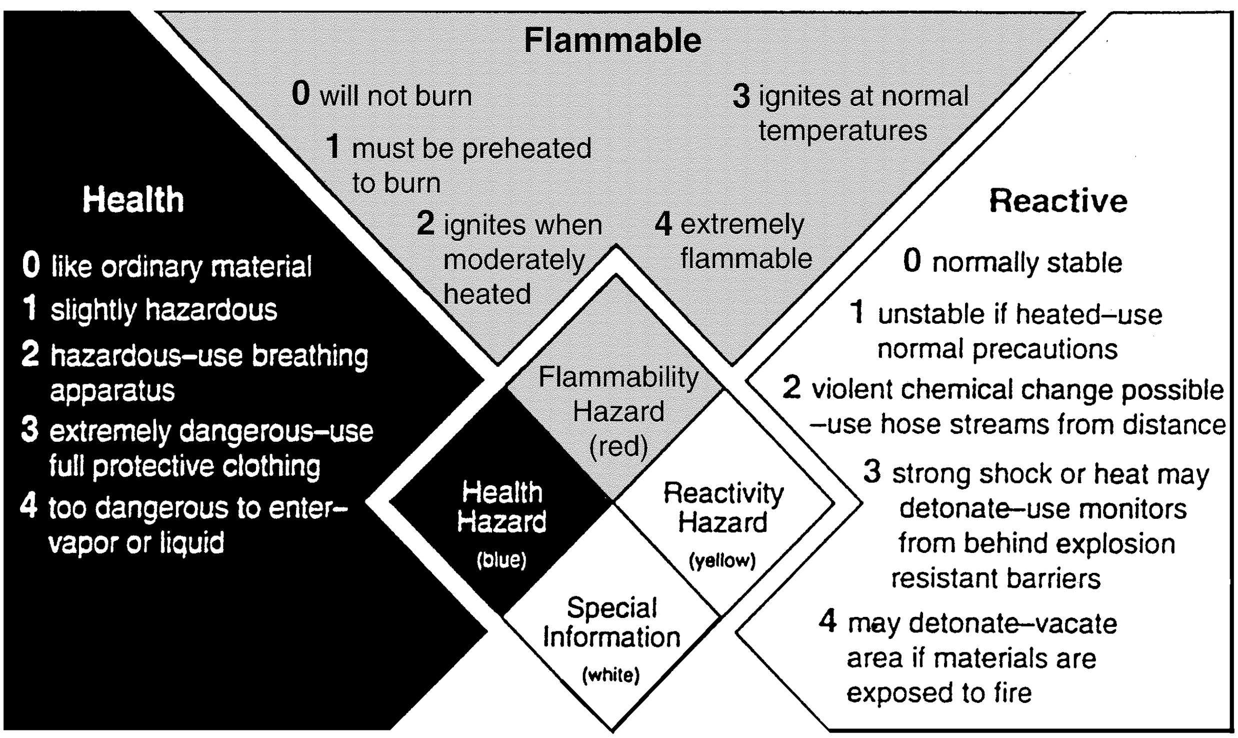
#	UN Hazard Class
1	Explosives
2	Gases (compressed, liquefied, or dissolved under pressure)
3	Flammable liquids
4	Flammable solids or substances
5	Oxidizing substances
6	Poisonous and infectious substances
7	Radioactive substances
8	Corrosives
9	Miscellaneous dangerous substances

Numbered placards, like the one pictured below, must be used on large portable tanks, tank trucks, and rail cars. The four-digit ID number that identifies the chemical is listed in the *DOT Emergency Response Guidebook.*

National Fire Protection Association (NFPA)—704M System

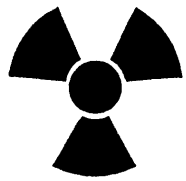
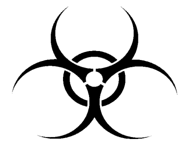
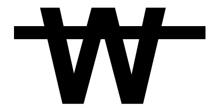
The National Fire Protection Association (NFPA) system may be used on storage vessels and containers at stationary facilities. Some facilities may use this system throughout their departments and put the NFPA label on all hazardous materials. The facility's hazard communication training should inform the worker if this warning system is being used at the work site. NFPA labels are diamond-shaped and four-colored. Each color represents a particular hazard. Numbers from 4 to 0 indicate degree of risk for health, flammability and reactivity.

Color	**Hazard**	**Risk** (for all hazards)
red	flammability	4 ____ Extremely High
blue	health risk	3 ____
yellow	reactivity	2 ____
white	special information	1 ____
	(such as radioactivity)	0 ____ Minimal

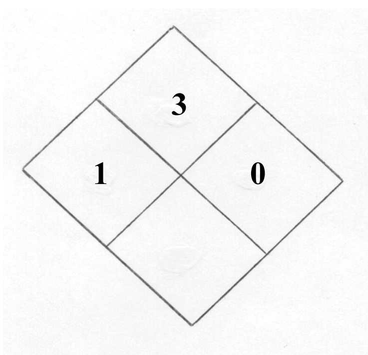


The special information (white) section of the NFPA 704M label may contain symbols that give more information about the chemical, as shown on the next page:

NFPA Special Information Symbols

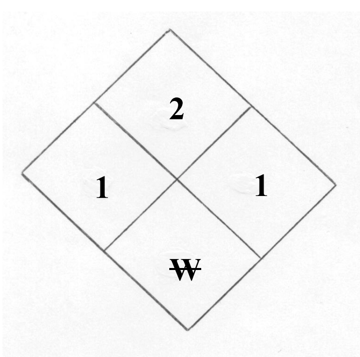
OXY			
Oxidizer	**Radiation Hazard**	**Biological Hazard**	**Do not use water.**

Here are some sample NFPA labels:



Acetone has:

Blue	A **health** rating of 1 (mild health danger)
Red	A **flammability** rating of 3 (heavy fire danger)
yellow	A **reactivity** rating of 0 (no unusual chemical reactions)



Isobutyric anhydride has:

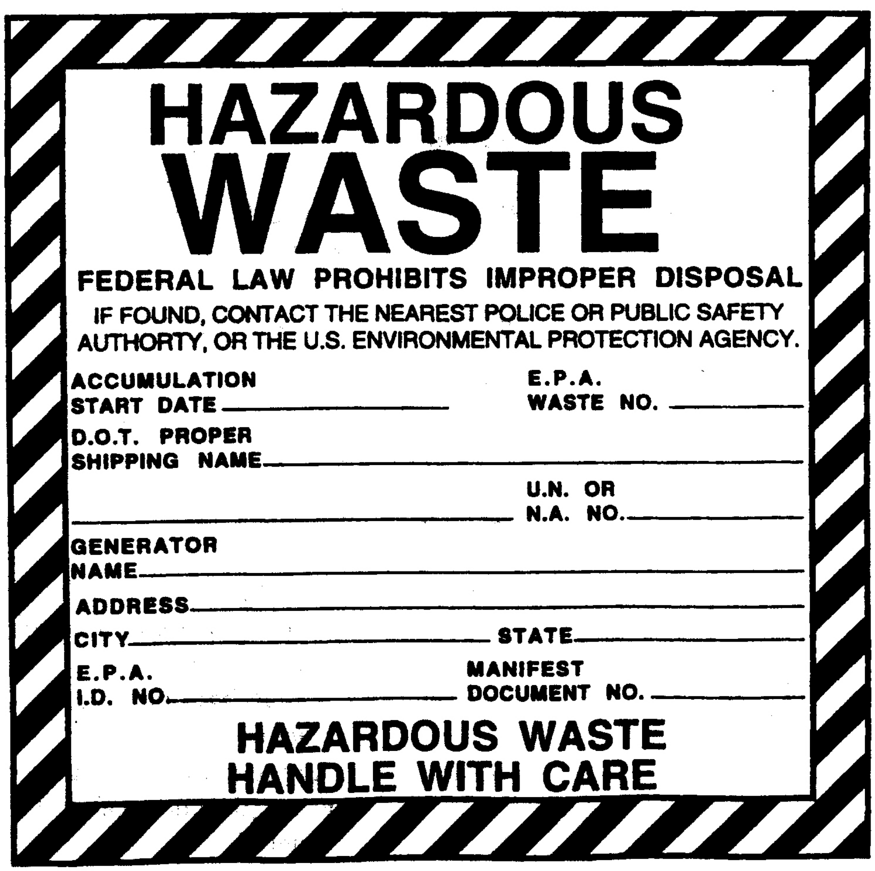
Blue	A **health** rating of 1 (mild health)
Red	A **flammability** rating of 2 (moderate fire danger)
Yellow	A **reactivity** rating of 1 (mild chemical reactions)
White	A **special hazard** symbol--do not use water (the chemical will react with the water)

Hazardous Waste Label

The hazardous waste label is required by the EPA for hazardous wastes in transit. The label can be any color or size. An example of a hazardous waste label is shown below.

Information on the label includes:

- the generator's name and address.
- DOT proper shipping name.
- EPA identification number.

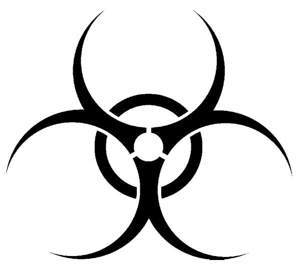

HAZARDOUS
WASTE
FEDERAL LAW PROHIBITS IMPROPER DISPOSAL
IF FOUND, CONTACT THE NEAREST POLICE OR PUBLIC SAFETY AUTHORITY, OR THE U.S. ENVIRONMENTAL PROTECTION AGENCY.

ACCUMULATION START DATE ____________ E.P.A. WASTE NO. ________
D.O.T. PROPER SHIPPING NAME ______________________________
______________________ U.N. OR N.A. NO. ________
GENERATOR NAME ______________________________
ADDRESS ______________________________
CITY ____________ STATE ____________
E.P.A. I.D. NO. ____________ MANIFEST DOCUMENT NO. ________

HAZARDOUS WASTE
HANDLE WITH CARE

Infectious Materials and Radioactive Symbols

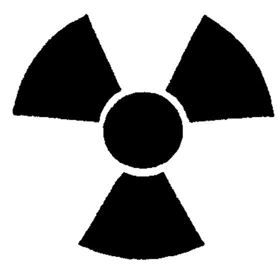
The most common type of packaged biological waste is probably infectious waste from hospitals and other health care facilities. This type of waste should be in boxes, plastic containers, or **red** plastic bags marked on all sides with the infectious materials symbol shown below.



Infectious Materials Symbol

Examples of infectious materials include used needles and syringes, soiled bandages, test tubes, and disposable vials. Less frequently encountered biological hazards would include biological research materials.

Radioactive sources are used in industry and medicine, and radioactive wastes result from energy and weapons production. Do not work with or around radiation hazards unless you have had special training. Radiation hazards should be covered in the Standard Operating Procedures (SOPs).



Radiation Symbol

All forms of radiation should be considered very hazardous.

Treat Them With Respect!

Material Safety Data Sheets (MSDS)

A very important information source on hazardous chemicals are **Materials Safety Data Sheets (MSDSs).** Your employer must maintain MSDSs on all hazardous chemicals used on the job. MSDSs do not cover hazardous wastes. You can however find information on hazardous wastes in shipping papers, manifest forms, and waste profile sheets.

MSDSs give you information on hazardous chemicals. MSDSs are sent with products at initial shipment.

MSDSs are **required** by the OSHA Hazard Communication Standard (29 CFR 1910.1200). But there is no standard format for MSDSs. Some MSDSs are 14 pages, others only 1. But every MSDS must, at a minimum, have these eight sections.

- Identity of chemical and manufacturer
- Hazardous Ingredients
- Physical and Chemical Characteristics
- Fire and Explosion Hazard Data
- Health Hazard Data
- Reactivity Data
- Precautions for Safe Handling, Use, and Disposal
- Control Measures

Although there is no standard MSDS form, the MSDS on the following pages is OSHA's sample MSDS form.

Material Safety Data Sheet

Material Safety Data Sheet May be used to comply with OSHA's Hazard Communication Standard, 29 CFR 1910.1200. Standard must be consulted for specific requirements.	U.S. Department of Labor Occupational Safety and Health Administration (Non-Mandatory Form) Form Approved OMB No. 1218-0072
IDENTITY *(As Used on Label and List)*	*Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the space must be marked to indicate that.*

Section I

Manufacturer's Name	Emergency Telephone Number
Address *(Number, Street, City, State, and ZIP Code)*	Telephone Number for Information
	Date Prepared
	Signature of Preparer *(optional)*

Section II — Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity; Common Name(s))	OSHA PEL	ACGIH TLV	Other Limits Recommended	% *(optional)*

Section III — Physical/Chemical Characteristics

Boiling Point		Specific Gravity (H_2O = 1)	
Vapor Pressure (mm Hg.)		Melting Point	
Vapor Density (AIR = 1)		Evaporation Rate (Butyl Acetate = 1)	

Solubility in Water

Appearance and Odor

Section IV — Fire and Explosion Hazard Data

Flash Point (Method Used)	Flammable Limits	LEL	UEL

Extinguishing Media

Special Fire Fighting Procedures

Unusual Fire and Explosion Hazards

(Reproduce locally) OSHA 174, Sept. 1985

Section V — Reactivity Data

Stability	Unstable		Conditions to Avoid
	Stable		

Incompatibility (*Materials to Avoid*)

Hazardous Decomposition or Byproducts

Hazardous Polymerization	May Occur		Conditions to Avoid
	Will Not Occur		

Section VI — Health Hazard Data

Route(s) of Entry:	Inhalation?	Skin?	Ingestion?

Health Hazards (*Acute and Chronic*)

Carcinogenicity:	NTP?	IARC Monographs?	OSHA Regulated?

Signs and Symptoms of Exposure

Medical Conditions
Generally Aggravated by Exposure

Emergency and First Aid Procedures

Section VII — Precautions for Safe Handling and Use

Steps to Be Taken in Case Material Is Released or Spilled

Waste Disposal Method

Precautions to Be Taken in Handling and Storing

Other Precautions

Section VIII — Control Measures

Respiratory Protection (*Specify Type*)

Ventilation	Local Exhaust	Special
	Mechanical (*General*)	Other

Protective Gloves	Eye Protection

Other Protective Clothing or Equipment

Work/Hygienic Practices

Page 2 ☆ U.S.G.P.O.: 1986-491-529/45775

How to Read an MSDS

Section l: Identification of Chemical and Manufacturer

IDENTITY (As used on Label and List)	Note: Blank spaces are not permitted. If any item is not applicable, or no information is available, the spaces must be marked to indicate that.
Section I	
Manufacturer's Name	Emergency Telephone #
Address (Number, street, city, state & zip)	Telephone # for Information
	Date Prepared
	Signature of Preparer (optional)

Section I identifies the product and manufacturer or supplier. The name of the product in this section must be the same as the name on the label of the container. The manufacturer's name, address, and phone number are also listed. If more than one name is used for a specific chemical, both names should be listed. Finally, the date the MSDS was prepared must be indicated.

Section ll: Hazardous Ingredients/Identity Information

Hazardous Components (Specific Chemical Identity ; Common Name(s)	OSHA PEL	ACGIH TLV	Other Limits Recommended	% (Optional)

Any chemical comprising 1% or more of the product (or 0.1% if the chemical is a carcinogen) and known to have hazardous properties must be listed in this section. Next to each hazardous ingredient, the OSHA (Permissible Exposure Limit) PEL, and the non-enforceable TLV must be listed. The NIOSH Recommended Exposure Limit (REL) may be listed under other limits recommended. OSHA PELS do not exist for all chemicals, so you may find MSDS that do not list PELS.

The Chemical Abstracts Service (CAS) number is specific for each chemical. If two or more chemicals with different names have the same CAS, they are the same chemical.

You may see the notation "skin" after a PEL or TLV. This notation indicates that the chemical can be easily absorbed into the body through the skin.

Trade secret claims have to be identified on the MSDS for any hazardous ingredients that are being withheld. These claims are usually indicated by the phrase "Proprietary Information," or "Confidential."

Section III: Physical and Chemical Characteristics

SECTION III—PHYSICAL DATA

BOILING POINT	SPECIFIC GRAVITY (H_2O = 1)
VAPOR PRESSURE (mm Hg.)	Melting Point
VAPOR DENSITY (AIR = 1)	EVAPORATION RATE (___=) (Butyl Acetate = 1)
SOLUBILITY IN WATER	
APPEARANCE AND ODOR	

This section lists boiling point, vapor pressure, vapor density, solubility, specific gravity, evaporation rate and the chemicals odor and appearance. (Evaporation rate indicates how fast the material will evaporate compared with a reference compound such as butyl acetate. If the rate is less than 1, the material evaporates less rapidly).

A chemicals appearance and odor can help you identify it. However, odor can be a poor identifier and is a poor measure of the concentration of the substance in the air. Many substances can reach hazardous levels with no noticeable odor. Others cause a olfactory fatigue (you become unable to smell the chemical).

Section IV: Fire and Explosion Hazard Data

SECTION IV—FIRE AND EXPLOSION HAZARD DATA

Flash Point (Method used)	Flammable Limits	LEL	UEL
Extinguishing Media			
Special Firefighting Procedures			
Unusual Fire & Explosion Hazards			

Section IV provides information on how to fight fires and explosions. It lists the type of fire extinguisher which should be used and whether special protective equipment is needed. This information probably will not help much in emergency situations when several chemicals are involved.

Under the federal Community Right-to-Know law, firefighters have the right to review workplace chemical inventories and MSDSs and to inspect the workplace in order to plan for and prevent fires and explosions.

Section V: Reactivity Data

SECTION V—REACTIVITY DATA

STABILITY	UNSTABLE	CONDITIONS TO AVOID
	STABLE	
INCOMPATIBILITY (Materials to Avoid)		
HAZARDOUS DECOMPOSITION or BYPRODUCTS		
HAZARDOUS	Will Occur	CONDITIONS TO AVOID
POLYMERIZATION	Will not Occur	

Section V tells you if the substance is stable. It lists incompatible chemicals that react dangerously with the substance. Information on incompatibles is important for proper handling and storage of the product.

Section VI - Health Hazard Data

Route(s) of Entry:	Inhalation?	Skin?	Ingestion?
Health Hazards (Acute and Chronic)			
Carcinogenicity	NTP?	IARC Monographs?	OSHA Regulated
Signs & Symptoms of Exposure			
Medical Conditions Generally Aggravated by Exposure			
Emergency and First Aid Procedures			

This section should list the routes of entry, signs and symptoms of exposure acute and chronic health effects, medical conditions aggravated by exposures, and emergency and first aid procedures. This information is often inadequate or incomplete.

> **Does It Cause Cancer?**
> An MSDS **must** list the chemical as a carcinogen (cancer causing) if it is listed as such by the International Agency for Research on Cancer (IARC) the U.S. National Toxicology Program (NTP) or OSHA. If two experiments have shown a harmful effect such as causing cancer in animals, this must also be listed.

Section Vll: Precautions for Safe Handling and Use

Steps To Be Taken In Case Material Is Released Or Spilled
Waste Disposal Method
Precautions to be taken in Handling and Storing
Other Precautions

This section lists clean-up procedures, safe disposal methods and precautions for handling and storage.

Section VIII: Control Measures

SECTION VIII—CONTROL MEASURES

Respiratory protection (specify type)		
Ventilation	Local exhaust	Special
	Mechanical (general)	Other
Protective gloves	Eye protection	
Other protective clothing or equipment		
Other Precautions		

Section VIII describes minimum measures necessary to reduce exposures to hazardous substances.

The recommended type of ventilation is listed in this section. Local exhaust ventilation which captures contaminants at the source is the most protective but is rarely recommended.

This section lists required PPE including respiratory protection and the recommended glove and clothing material. MSDSs often list “impervious” instead of a specific material to be used for gloves and chemical protective clothing.

Other Forms of Hazardous Materials Documentation

The DOT requires that every shipment of hazardous materials must carry documentation about the materials being shipped. The EPA requires that hazardous waste shipments are accompanied by hazardous waste manifests. Truck drivers are required to keep the papers, called a bill of lading, in the cab.

There should be shipping papers for all hazardous materials shipped to hazardous waste sites.

There is no standard format for shipping papers, but the following information required:

- Shipper's name and address
- Receiver's name and address
- Description of hazardous material
- DOT hazard classification information
- Quantity of material shipped to the location

An example of shipping papers is in Appendix C.

Hazardous Waste Manifest Forms

The hazardous waste manifest tracks hazardous wastes from the cradle-to-grave. The manifest has a number of copies which are given to the generator, the transporter, and site characterization workers. Manifest information includes:

- the identification number, name, and address of the generator.
- the identification number, name, and address of the permitted work site.
- the identification number and name of the hazardous waste hauler.
- a description of the contents.

An example of a hazardous waste manifest is in Appendix C.

Waste Profile Sheets

The waste profile sheet is provided by the laboratory that conducts the analysis of the hazardous waste. The profile sheet describes the physical and chemical properties of the waste sample. Information from waste profile sheets is important for site characterization. A sample is found in Appendix C.

Limitations of Documentation

Although the MSDS, shipping papers, manifest forms, and waste profile sheets contain important information, they have a number of limitations.

- Information may be incomplete or inaccurate.
- Information may not apply to the site or specific use.
- Information may be too general.
- MSDS may not be current.

It is important that you read these documents before there is an emergency. It is a good practice to call the emergency number on the MSDS to get clean-up response and emergency information before there is an emergency.

SUMMARY: MATERIAL IDENTIFICATION

Containers and trucks may have different kinds of labels that can tell you about the chemicals inside. Containers must have OSHA hazard labels. Shipping containers must also have colored DOT labels (small). Trucks and railroad cars must have colored placards. The main colors are:

orange	explosive
red	flammable
white with black letters	poisonous
yellow	oxidizer (reactive) or radioactive
blue	water reactive
green	non-flammable gas (high pressure)
black and white	corrosive or other

Some localities use the NFPA diamond, which shows health (blue), fire (red), reactive (yellow), and special (white) hazards.

Material Safety Data Sheets (MSDS) may be on site for some wastes and must be on site for all products used to do cleanup. The MSDS tells you what chemicals are in the product, chemical information, health and physical hazards, exposure limits, first aid, and spill precautions.

Every shipment of hazardous waste that leaves the cleanup site must have a form called a manifest that tells what the wastes are and where they come from.

Before you start work on a cleanup site, the lab has sent over information about chemicals on site called Waste Profile Sheets. These are a source of information about the chemical and physical properties of the waste.

Labels, MSDSs, manifests, shipping papers, and waste profile sheets can be valuable sources of information for the contractor and the worker.

BACKGROUND READING MATERIAL: HAZARD RECOGNITION

NIOSH Pocket Guide to Chemical Hazards. (2000). U.S. Department of HHS, PHS, CDC, NIOSH.

Hawley's Condensed Chemical Dictionary. Sax and Lewis. (1987). Van Nostrand Reinhold & Co., 115 Fifth Ave, N.Y. 10003 (11th ed.)

Chemical Hazards of the Workplace Fischman, M.L., Hughes, J.P., & Proctor, N.H. (1988).(2nd ed.). J.B. Lippincott Company, Philadelphia, PA.

Hazardous Substance Fact Sheets. New Jersey Department of Health. Trenton, NJ 08625.

Occupational Health Guidelines for Individual Chemicals. U.S. Department of Labor. Occupational Safety and Health Administration.

Hazardous Waste Operations and Emergency Response; Final Rule (29 CFR 1926.65)

Hazard Communication Final Rule (29 CFR 1910.1200)

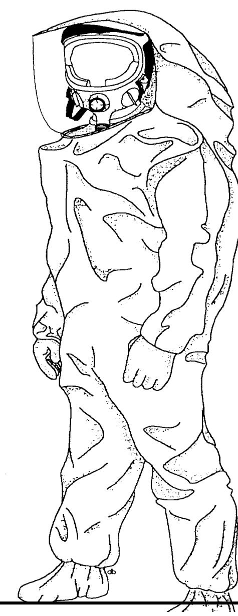
Occupational Safety and Health Guidance Manual for Hazardous Waste Sites, 1985. (NIOSH #85-115)

EPA's Standard Operating Safety Guides, July, 1988.

Emergency Response Guidebook, U.S. Department of Transportation.

CHAPTER 4: PERSONAL PROTECTIVE EQUIPMENT-- PPE

Engineering and administrative controls may not always be feasible on hazardous waste sites. Personal protective equipment (PPE) is required by OSHA and the EPA for all contractors working on Superfund sites. PPE shields or isolates individuals from the chemical, physical, and biological hazards at hazardous waste sites. Careful selection and use of adequate PPE should protect the respiratory system, skin, eyes, ears, hands, feet, and head.



Chapter Objectives

After this training, you will be able to:

- ☞ Recognize if the right protective gear is being used.
- ☞ Put on and take off this gear properly.
- ☞ Use safety gear within its limits (for example, a chemical protective suit will not protect you at all from fire. In fact it will melt right away).
- ☞ Inspect, clean, and store this protective equipment so that it will continue to protect you.

CASE STUDY

Two workers were removing paint from a small process room. Methylene chloride was applied to the walls using brushes and rags. The workers wore coveralls, vinyl gloves, and full-face respirators with organic vapor cartridges. After an hour in the room, the workers felt eye and throat irritation but continued to work. After two hours, one of the workers was dizzy and both workers left the area.

The high levels of methylene chloride in the room used up the charcoal in the organic vapor cartridges. Skin absorption through the gloves and coveralls added to the problem. After 45 minutes the workers had begun to breath in large amounts of the chemical, but ignored the warning signs of exposure until they became too sick to keep working. The employer did not have an adequate respirator program because no one was assigned to make sure that the cartridge life was not exceeded. The workers were not trained to recognize the signs of exposure to the chemicals that they were using.

SECTION I – PERSONAL PROTECTIVE EQUIPMENT PROGRAM (PPE)

A written personal protective equipment (PPE) program is required by OSHA as part of the employer's safety and health program. Selected PPE must be capable of protecting employees from known or potential hazards. The PPE program must address:

- selection, based upon site hazards
- use and limitations
- work task duration
- maintenance and storage
- decontamination and disposal
- training and proper fitting
- putting on and taking off equipment before, during, and after use
- inspection procedures
- evaluation of the effectiveness of the PPE program
- special limitations during temperature extremes, heat stress, and other appropriate medical considerations

The preliminary site evaluation should provide enough information to select the appropriate PPE. If there is not enough information for selection, OSHA mandates a high level of skin and respirator protection (called Level B), along with the use of special equipment to monitor the air (1926.65 (c) (5) (i) and (iii)).

OSHA addresses PPE in 29 CFR 1926 Subpart E

1926 Subpart E	
■ 1926.95	General requirements
■ 1926.96	Foot Protection
■ 1926.100	Head Protection
■ 1926.101	Hearing protevtion
■ 1926.102	Eye and Face Protection
■ 1926.103	Respiratory Protection
■ 1926.104	Safety belts, lifelines and lanyards
■ 1910.138	Hand Protection

RESPIRATORY PROTECTION

Respiratory protection is required at hazardous work sites when adequate protection cannot be provided by engineering or administrative controls. This section outlines the uses and limitations of different types of respiratory protection.

Respirators provide protection against chemical and dust exposures. Employers must provide workers with appropriate respirators and annual training (although employees are permitted to bring their own). OSHA Standard 29 CFR 1926.103 requires that employers develop a written respiratory protection program if workers may be required to wear respirators or if respirators are available for voluntary use.

Consult the site-specific respirator program for detailed requirements on your worksite

Making Sure Respirators Protect You

Your employer's written respirator program should make sure respirators protect you with these five steps:

1) A medical exam for respirator use–not just an annual physical.

2) Choosing the right respirator and/or filter/cartridge combination--using air monitoring results.

3) Training about how to use and care for the type of respirator you will use.

4) Making sure the respirator you will wear fits you--fit tests and fit checks.

5) Maintaining the respirator--cleaning, inspecting, repairing, and storing it.

Minimum Requirements for a Respirator Program

OSHA requires employers whose employees use respirators to have a written respirator program. The program should be evaluated at least annually, or as requirements change, and changed when the workplace changes. A written respirator program must include the following points:

- how to **choose** the right approved respirator for each job
- what **medical exams** are needed
- the tests that will be done to make sure respirators **fit** properly--fit tests
- rules for **using** respirators
- how to **clean, store, and maintain** respirators, including a schedule for replacing filters
- air quality when supplied air is used
- training in air hazards you work around
- annual respirator training
- how the program will be **evaluated** and **who is in charge**

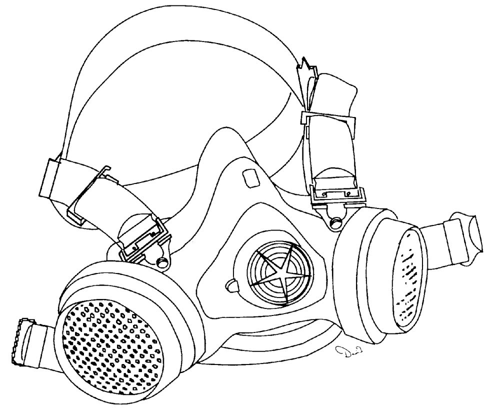
Choosing the Right Respirator

Selecting the correct respirator for the hazard is the responsibility of qualified personnel. Choosing the wrong respirator may be life-threatening. All respirators must be approved by the National Institute for Occupational Safety and Health (NIOSH). Procedures for selecting respirators must be part of your employer's written program. To select the correct respirator a qualified person must first **test the air** and then know:

- The percentage of oxygen in the air
- What hazardous substances workers may be exposed to
- The concentration of the substance in the air; is it IDLH?
- Permissible Exposure Limit (PEL) for the substances involved
- That the respirator is approved for the application
- If the contaminant is hazardous to skin and eyes

<u>Types of Respirators</u>

There are two basic types of respirators:



1. Filter or **Air-Purifying Respirators** (APR) filter contaminants out of the air before it is breathed in.

2. Hose or **Supplied-Air Respirators** (SAR) supply clean breathing air through a hose.

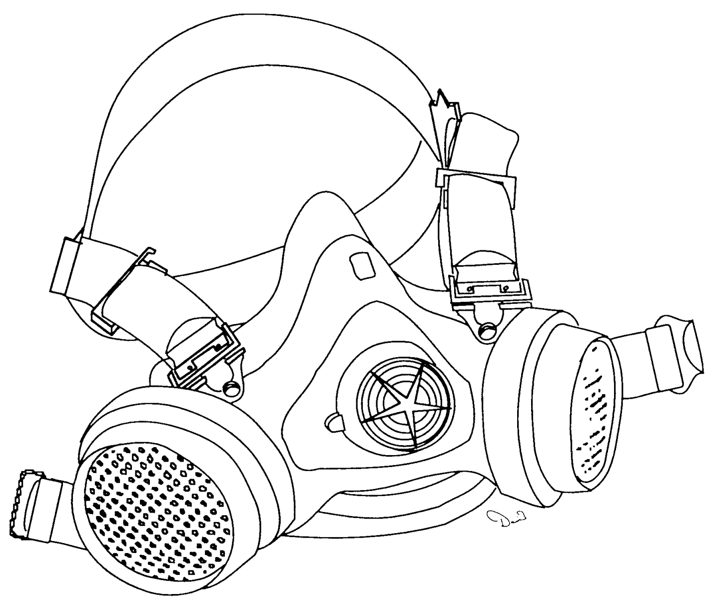
   - Airline respirators supply air through an airline from a tank or compressor to the wearer.

   - Self-Contained Breathing Apparatus (SCBA) supplies the air from a tank on the wearer's back.

Air-Purifying Respirators

Air-Purifying Respirators (APRs) are used to protect against dusts and some toxic chemicals. They work by filtering air before it is inhaled. APRs consist of a facepiece with one or two filtering cartridges through which the air enters and an exhalation (out) valve near the chin. The most widely used facepieces are full-face or half-mask. A half-mask respirator and a full-face respirator are shown on the following pages. Paper disposable dust masks should <u>never</u> be used on a hazardous waste site.

APR's may be used <u>only</u> if:
• There is at least 19.5% oxygen in the air. • All contaminants are identified. • The concentration of the contaminant is known and is within the limits of the APR. • The concentration of the contaminant is below the IDLH level. • The contaminants have good warning properties (smell, irritation).



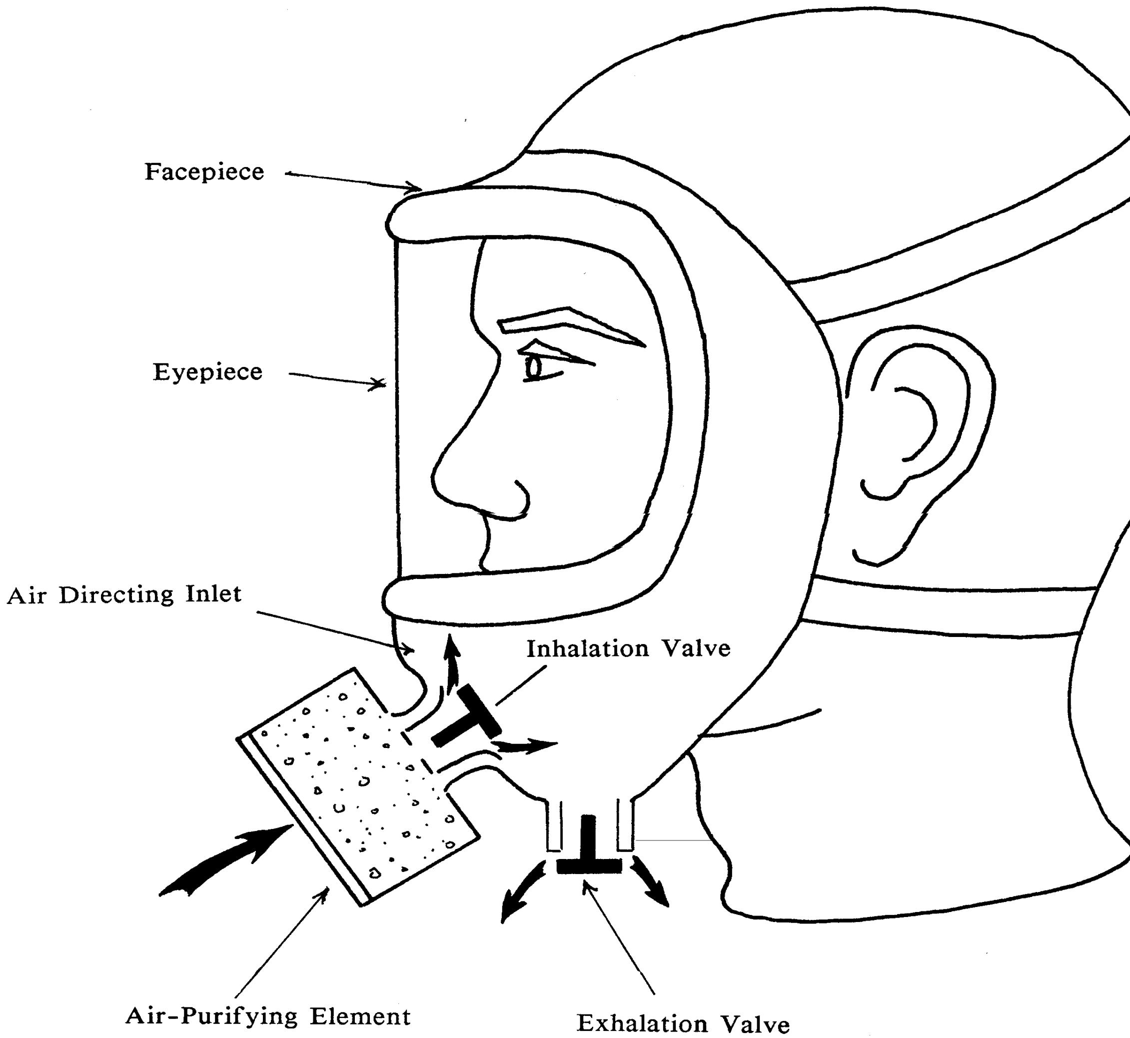
<u>Half-Mask Air-Purifying Respirator</u>

Remember, APR's may <u>NEVER</u> be used when the oxygen content is less than 19.5%. Half-mask respirators are generally <u>not</u> recommended for use on hazardous waste sites.

Full-Face Air-Purifying Respirator

Operation of an Air-Purifying Respirator

Air enters through the cartridges and exits through a valve. Note the proper placement of the headbands.



Typical full-facepiece respirator

Workers who wear glasses will need a special kit, since the side pieces on the glasses will let air leak in around the sides of the mask.

Filters and Cartridges

Two types of air purifiers (cleaners) are used with APRs.

- **Particle filters** to protect against dusts, mists, and fumes (tiny metal particles)
- **Chemical cartridges** to protect against vapors and gases

Filters and cartridges are chosen based on the contaminant. Procedures for selecting filters must be part of your employer's written program. The size of the particles, concentration of the substance, and type of filter affect how well the APR works. Dust filters do not keep out fumes (tiny metal particles from welding). Special fume filters must be used.

Chemical Cartridge Respirators Do Not Protect You From :			
1.	Acrolein	15.	Methylene Bisphenyl Isocyanate
2.	Aniline	16.	Nickel Carbonyl
3.	Arsine	17.	Nitro Compounds, including
4.	Bromine		Nitrobenzene
5.	Carbon Monoxide*		Nitrogen Oxides
6.	Dimethylaniline		Nitroglycerin
7.	Dimethyl Sulfate		Nitromethane
8.	Hydrogen Cyanide	18.	Ozone
9.	Hydrogen Fluoride	19.	Phosgene
10.	Hydrogen Selenide	20.	Phosphine
11.	Hydrogen Sulfide	21.	Phosphorus Trichloride
12.	Methanol	22.	Stibine
13.	Methyl Bromide	23.	Toluene Diisocyanate (TDI)
14.	Methyl Chloride	24.	Vinyl Chloride

How do you tell if the cartridge needs to be changed?

When a particulate filters become "loaded" it becomes difficult to breathe through. Gas/vapor cartridges **should** be replaced at least every shift. Based on the chemicals and their concentrations, filters may need to be changed more often. Your employer's written program must include a change schedule (unless the filter has a dot that changes color, called an indicator). Once you smell or taste a contaminant, you must change your cartridges. But you should not wait until that point--if your sense of smell is weakened you may be working with a useless cartridge and not even know it.

NIOSH Approved Colors and Protection Combination

Contaminants	Color Assigned
Acid gases	White
Hydrocyanic acid gas	White with ½-inch green stripe completely around the canister near the bottom
Chlorine gas	White with ½-inch yellow stripe completely around the canister near the bottom
Organic vapors	Black
Ammonia gas	Green
Acid gases and ammonia gas	Green with ½-inch white stripe completely around the canister near bottom
Acid gases and organic vapors	Yellow
Hydrocyanic acid gas and chloropicrin	Yellow with ½ inch blue stripe completely around the canister near the bottom
Acid gases, organic vapors, and ammonia gases	Brown
Radioactive materials, excepting tritium and noble gases	Purple (magenta)
Particulate (dusts, fumes, mists, fogs, or smoke) in combination with any of the above gases or vapors	Canister color for contaminant, as designated above, with ½-inch gray stripe completely around the canister near the top
All of the above atmospheric contaminants	Red with ½-inch gray stripe completely around the canister near the top

Note: Carbon monoxide canisters (blue) are used only for escape. The user should always refer to the cartridge or canister label to determine the degree of protection the canister will afford and to make sure that it is the right one for the exposure.

Other Air-Purifying Respirators

A special type of APR is a Powered Air-Purifying Respirator (PAPR), which pulls air through the filters and blows it into the mask. PAPRs consist of a hood or helmet, filter, power source, and a facepiece. PAPRs can be used only in environments where there is enough oxygen.

Self-contained Breathing Apparatus (SCBA)

Self Contained Breathing Apparatus (SCBA) supply clean breathing air from a tank carried on the wearer's back. Full facepiece SCBAs operated in a positive pressure - pressure demand mode offer the best respiratory protection. The usefulness of SCBAs is limited by the amount of air which can be carried in the tank on the wearer's back.

SCBA and airline SAR with escape bottle are the most protective forms of respiratory protection.

SCBA or airline SAR with escape must be used when:

- the oxygen content of the air is less than 19.5%
- the contaminant and/or its concentration are unknown
- the concentration of the contaminant is IDLH or above the concentration safely handled by a less protective respirator.
- there is an emergency

There are several different brands of SCBAs on the market. <u>You must be fit tested and trained to use the SCBA your employer gives you</u>. Each SCBA will have different checkout procedures and manufacturer's instructions. <u>Do not attempt to use an SCBA without proper training</u>.

Sometimes workers need to go into areas where the air is extremely dangerous. These are called Immediately Dangerous to Life or Health (IDLH) areas. <u>Whenever SCBAs or SARs are used in these areas, there must be a trained worker outside who is in constant contact with the worker inside.</u> Provisions must be made for rescue.

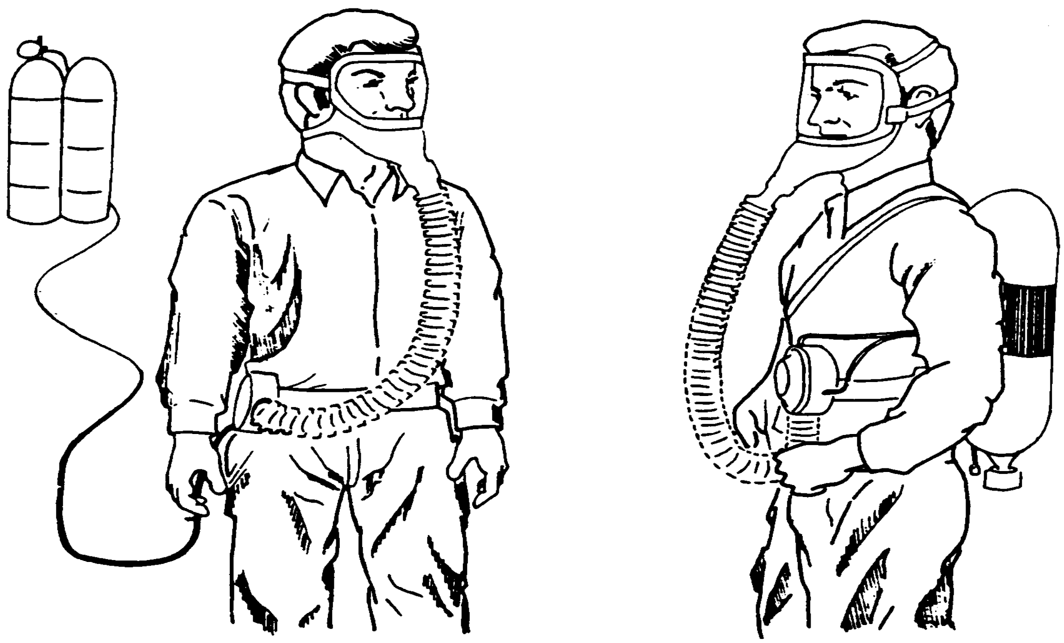
Supplied-Air Respirators (SAR)

Airline respirators supply breathing air from a tank or compressor through an airline to the wearer's mask. Airline hoses must never exceed 300 feet from the air source to the wearer.

Never go further into a contaminated area than can get out of in five minutes. The escape bottle is rated at only five minutes.

For the greatest protection, airline respirators should be used with a full facepiece and operated in a positive pressure/ pressure demand mode. An escape bottle should always be used with airline SAR's in case the hose is cut or damaged.[1]

Supplied-Air Respirator hoses are a problem when there is any moving equipment. The hose can get cut, run over, or tangled up in equipment. Often hoses are covered with plastic or duct tape to keep chemicals off of them.



Compressors used to supply air must meet special requirements. Compressor exhaust must not contaminate the air it supplies. To avoid contamination of supplied air, locate compressor air intakes in a contaminant-free area. Procedures for protecting hoses and ensuring clean air must be part of your employer's written program.

[1]In this manual, when we say "SCBA" we always mean a positive-pressure / pressure-demand full-facepiece (modern style) minimum 30-minute SCBA approved by NIOSH. When we say SAR we always mean a positive-pressure / pressure-demand full-facepiece (modern style) SAR with an escape bottle approved by NIOSH.

Respirator Fit, Use, and Maintenance

Studies show that a respirator that is fitted properly, put on correctly, and properly cleaned, stored and maintained will protect you 2 ½ times as well as one that is not used correctly.

A tight-fitting respirator will protect you only if it seals against your face. You must be fit-tested before you use a respirator and once a year after that. Fit-testing can be either qualitative (subjective) or quantitative (measured with a computer). You must also do routine positive- and negative-pressure fit checks. Procedures for annual fit tests and routine fit checks must be part of your employer's written program.

Faces come in different sizes; so do respirators. The purpose of fit testing is to find the manufacturer/size combination which offers you the best protection. Weight loss or gain, scars, dentures, dental work, or facial injury can change the way the respirator seals to your face. Facial hair prevents the respirator from sealing to your face

Annual Fit Tests

Qualitative and **Quantitative** fit-testing are used to find the size and model of respirator you should wear. They also indicate how good the face-to-facepiece seal is. These tests must be repeated every year to ensure the proper fit, and your employer must keep a record of the tests.

Qualitative (Taste/Smell) Testing

Purpose: Wearer determines whether substances are entering the facepiece.

Method: While wearing a respirator you are exposed to a test substance which is an irritant (smoke) or has a strong odor (banana oil) or a sweet or bitter taste (saccharine or Bitrex). If you smell or taste the substance you have a respirator that will not protect you because it does not fit.

Requirements: This test is required by 1926.103 and must be done whenever respirator design or facial changes occur that could affect respirator fit. In practice, this means at least once a year.

Weaknesses:

- Some of the test substances can irritate the eyes or cause coughing
- A poor sense of smell or taste may result in an inaccurate test
- Fit-testing is often done in "ideal" environments that do not reflect real working conditions. Test conditions will not show how a respirator will fit in different temperatures and during hard *physical work*

Quantitative (Computer) Testing

Purpose: Measures effectiveness of respirator in keeping contaminants from entering the facepiece.

Methods: You are put inside a test chamber wearing a respirator that has a probe in the facepiece. A test substance is released and the concentrations inside and outside of the respirator are measured. (Newer versions of the test measure how much room dust is in the air outside and inside the respirator.)

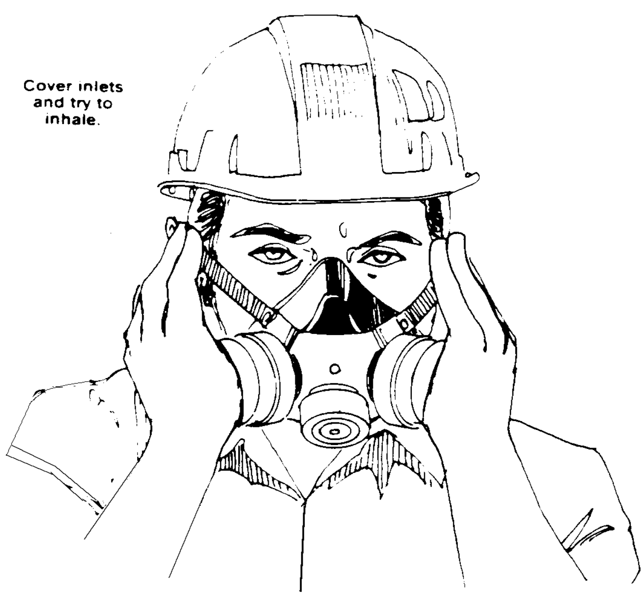
The test is repeated while you do activities (speaking, running in place, etc.) that may affect fit.

Requirements: This test is required by OSHA for all Supplied-Air Respirators (SARs). It is a good safety practice for Air-purifying Respirators (APRs) too.

The test measures the effectiveness of a specific respirator for the person who will wear it. The test provides a fit factor (FF), which is a comparison of the concentration of the substance outside of the mask to the concentration inside of the mask. A disadvantage to this test, which is much more accurate than qualitative fit testing, is that special equipment and trained personnel are needed to administer it.

Routine Respirator Fit-Checks

Both positive pressure and **negative-pressure** fit checks must be done **each** time you use a respirator. These quick tests do not replace yearly fit-testing but provide a routine check on whether the respirator is on your face properly.



NEGATIVE PRESSURE (SUCK IN) CHECK

Positive-Pressure (Exhale) Check

Purpose: Checks the respirator for leaks at valves or other points.

Method: Cover the exhalation (out) valve with your hand and blow out. The facepiece should expand but not break the seal.

Required: Before each use.

Negative-Pressure (Inhale) Check

Purpose: Checks the facepiece-to-face seal.

Method: For an APR place your hands or latex gloves over cartridges and inhale. For an SCBA or SAR, disconnect the hose at the regulator, cover the end of the hose and inhale. No outside air should leak into the face-piece.

Required: Before each use.

Positive- pressure and negative-pressure checks can be done quickly and easily in the field.

Respirator Protection Factors

Respirator protection factors (PF) are determined by either NIOSH, or ANSI or NRC. Each type of respirator has an assigned Protection Factor (PF). A low Protection Factor (PF) means the respirator does not protect you as much. For example, according to NIOSH, a full face-piece Air-Purifying Respirator with organic vapor cartridges has a Protection Factor (PF) of 50. An SCBA has a Protection Factor of 10,000. The Air-Purifying Respirator will let more contaminant into your face-piece than the SCBA will. (See Appendix C for a chart of all NIOSH Assigned Protection Factors).

According to ANSI, a full-face Air-purifying Respirator with organic vapor cartridges has a protection factor of 100. DOE sites have a directive to use ANSI Standards to determine which respirators to use. They also use TLVs, which are usually lower than PELs, when selecting respirators.

Be sure to check which system your employer is using.

NIOSH Assigned Protection Factors

Half-face	=	10
Full-face	=	50
*SAR	=	2,000
SCBA	=	10,000

ANSI Assigned Protection Factors

Half-face	=	10
Full-face	=	100
SAR	=	1,000
SCBA	=	Up to 10,000

*SAR in the positive pressure/pressure demand mode with an escape bottle has a protection factor of 10,000 under NIOSH recommendations.

If you know a respirator's Protection Factor, you can figure out if that respirator will protect you against a given concentration of a contaminant. You need to make sure that the amount of the chemicals that the respirator lets in is below the combined OSHA Permissible Exposure Limits for all chemicals in the workplace air.

This is the formula to use:

$$\frac{\textbf{Concentration of chemical in ppm}}{\textbf{Respirator's PF}} = \text{The concentration of the chemical that will get into the respirator. This number must be lower than the chemical's PEL.}$$

<table>
<tr><td colspan="2">Here is an example:
The OSHA PEL for o-xylene is 100 ppm. You are working in an atmosphere where the concentration of o-xylene is 800 ppm. Which of the two respirators below would you rather have to protect you against the chemical ?</td></tr>
<tr><td>A half-face Air-Purifying Respirator with a Protection Factor of 10?

$\frac{800\text{ ppm}}{\text{PF of }10}$ = 80 ppm could get inside your respirator

LESS PROTECTIVE</td><td>a full face-piece Air-Purifying Respirator with a Protection Factor of 50?

$\frac{800\text{ ppm}}{\text{PF of }50}$ = 16 ppm could get inside your respirator

MORE PROTECTIVE</td></tr>
</table>

A properly fitted full face-piece Air-Purifying Respirator would give you much better protection than half-face Air-Purifying Respirator.

Medical Fitness to Wear a Respirator

Before you may wear a respirator, you must be given medical clearance as determined by a physician or other licensed health care professional. A questionnaire is supposed to show that you are not at risk from the added stress of a respirator. If you answer "yes" to anything on the questionnaire, you must get a physical exam. The questionnaire is repeated if you have health problems, fit problems, or the workplace changes. The health care provider must be told what your job involves. Your employer keeps a copy of the exam findings with your other workplace records.

The medical report must be limited to your ability to wear a respirator. Medical conditions which could keep you from wearing a respirator include:

- lung disease
- severe high blood pressure
- punctured eardrum
- claustrophobia (fear of small spaces)
- heart disease

Facial Hair and Respiratory Protection

Section 1910.134 (g) (1) (i) of the OSHA General Industry Standards states:

> "The employer shall not permit respirators with tight-fitting face-pieces to be worn by employees who have (A) facial hair that comes between the sealing surfaces of the face-piece and the face . . . or (B) any condition that interferes with the face-to-face-piece seal."

OSHA says there cannot be any facial hair when you use a respirator that relies upon a good face-to-face-piece seal. This includes any tight-fitting (as opposed to helmet or loose-fitting hood) air-purifying respirators. Even a heavy stubble can reduce the security of a face-to-face-piece seal.

Studies clearly show that facial hair will reduce the protection provided by respirators, particularly negative-pressure respirators. Twelve out of 14 studies showed that leakage increased 20 to 1,000 times when there was facial hair. Rules about facial hair must be part of your employer's written program.

Inspection, Maintenance, And Storage of Respirators

Respirators should be inspected before and after each use and checked <u>at least monthly</u>, even if not used. Most construction workers are responsible for doing this themselves. Procedures for inspecting, maintaining, and storing respirators must be part of your employer's written program. Your employer's policy may include more frequent inspections.

Inspection for all respirators:

- Check the condition of the face-piece
- Check the headbands to make sure that they can be tightened to provide a good fit

For SCBA and SAR:

- Check the hose and the points where the hose attaches to the face-piece and to the air tank
- Check the head and tank harnesses for cracks, tears, or other defects
- Check the regulator according to the manufacturer's directions
- Check the air tanks or compressor for damage
- Report defects or unusual conditions immediately
- Practice putting on the respirator routinely if used infrequently or if used for emergency purposes only

Cleaning and disinfecting for all respirators:

- Inspect each piece
- Wash the face piece following the manufacturer's instructions
- Air dry
- Reinspect the pieces as they are put back together
- Store away from dust, sunlight, heat, extreme cold, high humidity, and chemicals

For SCBAs and SARs:

- Remove the air tank or hoses
- Inspect each piece
- Wash the face-piece, hose, and harness following the manufacturer's instructions with disinfectant soap and water
- Air dry
- Do not submerge SCBAs in water
- Follow the manufacturer's specialized instructions

If you find something wrong with your respirator,
do not try to fix it yourself.
Find out who is authorized to do repairs
in your site-specific respirator program

SUMMARY: RESPIRATORY PROTECTION

Respirators are used to prevent toxic materials from entering your body through your lungs. Selecting the right respirator and filter or cartridge can be a matter of life or death. Situations where you must not use an air purifying respirator (APR) include:

- not enough oxygen (less than 19.5%)
- levels of hazardous substances in the air above set limits
- atmosphere immediately dangerous to life and health (IDLH)
- skin hazards where you must wear a fully encapsulating suit

A respirator that filters the air is called an Air Purifying Respirator or APR. It has a face-piece, an exhalation (out) valve, and one or two filters where the air enters. Respirator cartridges may be for particulates, vapors, or both. Your employer must have a change schedule unless the cartridge has an end of service life indicator (ESLI). An APR can only be used if there is enough oxygen in the air.

An air tank or firefighter's respirator is called a Self-Contained Breathing Apparatus or SCBA. It is for areas with low oxygen, high levels of chemicals, very toxic chemicals, or fires. It has a face-piece, a 30-60 minute tank of air, a gauge, a low-pressure alarm, and a safety valve. Routine training and practice is necessary if SCBAs are used.

A third kind of respirator has a long hose that supplies air. If air-line respirators are used, a small bottle of air for escape must also be worn. The long hose must be protected from chemicals and cuts.

A respirator is only as good as its fit. You need a fit test before you wear a respirator and once a year after that. The two kinds of fit tests are qualitative (yes or no) or quantitative (computer). Before each use, you must also do positive- and negative-pressure fit checks.

You must answer a respirator medical questionnaire with a licensed health care professional before your fit test.

Respirators do not work well unless they are cleaned, inspected, and stored safely. Respirators must be inspected before and after each use or monthly if not used routinely.

A written respirator program is required. Special considerations in use of respirators include beards, eyeglasses, communication, and use in IDLH atmospheres (such as low oxygen or chlorine leaks).

Important respirator terms include:

- APR air-purifying respirator
- IDLH immediately dangerous to life or health
- PAPR powered air-purifying respirator
- SAR supplied-air respirator -
- SCBA self-contained breathing apparatus

SECTION II—PROTECTIVE CLOTHING

PPE provides an important barrier between chemicals or other hazards in the environment and your body. Although PPE cannot provide protection from all exposures, when properly selected and worn, it can prevent excessive exposures.

Chemical-Protective Clothing

Chemical-Protective Clothing (CPC) is used to protect employees from both chemical and physical hazards. CPC is an important part of a hazardous waste site worker's protective equipment.

Chemical-protective clothing includes suits, booties, boots, gloves, and hoods which are made of special materials. These materials are chemical-resistant, which means they act as a barrier to keep chemicals from coming in contact with your skin. It is critical to select CPC which is designed to protect against the specific chemicals on your site. Otherwise, you might not be protected, even when you think you are.

Types of Chemical-Protective Suits

Chemical-protective suits are of two general types, totally encapsulating and partially encapsulating.

- **Vapor Tight Totally Encapsulating Chemical-Protective Suit (TECP)**: Provides head-to-toe coverage to protect the wearer from chemicals. These "moon suits" have special seams and zippers to prevent chemicals from leaking into the suit. They are gas/vapor-tight and have exhalation valves. TECPs are used when the highest levels of skin and respiratory protection are needed. These suits have a face shield which is part of the hood..
- **Chemical Protective Suit**: Provides good protection from chemicals and may or may not have face shields. These suits are not totally encapsulating, are not vapor tight, and do not have exhalation valves. They provide less skin protection than vapor tight suits. These suits are used when less skin protection is needed. The hood can either be part of the suit or detached.

Disposable suits, which provide limited protection from chemicals, can be used alone or in conjunction with these chemical-protective suits.

Selection of CPC should be explained in the safety and health plan. Selection is based on potential exposure. Totally encapsulating suits may be required for moving leaking drums, whereas partially encapsulating suits may be okay for operating a remote (robot) drum handler. The level of protection provided must be reevaluated as additional site information is gained. Guidelines for selection of PPE, including CPC suits, are presented in the table on the following page.

CPC Selection Guidelines

Chemical resistance: Different materials are resistant to different chemicals. Even water can breakdown some materials. CPC should provide protection against the chemicals likely to be at the site. This is true for whole-body as well as hand and foot protection.

Resistance to temperature extremes: Heat and cold can adversely affect CPC. Clothing which will be worn in cold temperatures could crack or become ineffective against chemicals. Likewise, heat may destroy the chemical resistance of clothing or even melt it.

Ability to be cleaned: Clothing must either be decontaminated after each use, or disposed of after use.

Cost: CPC is expensive, but buying less expensive, inferior products which do not adequately protect employees can be more expensive in the long run (increased medical costs, and lost work time).

Flexibility: Materials need to be flexible enough for the wearer to move and work safely. Overly rigid suits can result in unnecessary accidents from slips, trips, and falls. Gloves which are too rigid can make gripping difficult. This can lead to other hazards.

Size: CPC should be available in a variety of sizes to accommodate different sized workers. Suits that are too small will tear easily and provide no protection. Suits that are too large will make walking and working difficult. Safety boots that are too big will create both tripping and comfort problems. Gloves that don’t fit well make using equipment difficult and dangerous.

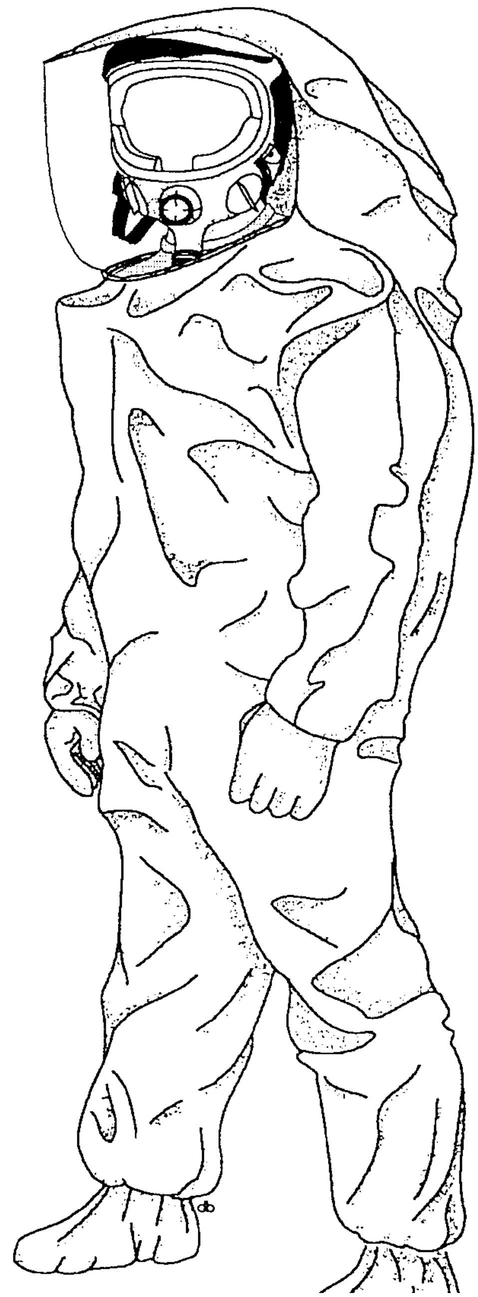
Levels of PPE

Level A

Level A is the highest level of skin and respiratory protection which can be worn by a site worker.

Level A Should Be Worn When :

- the identified substances require the highest level of protection for skin, eyes, and respiratory system
- there is potential for splash, hand or foot, immersion, or exposure that may harm or be absorbed through the skin
- skin absorption may result in immediate death or serious illness/injury or impair the ability to escape



Level A Consists Of :

- An SCBA or SAR
- Totally encapsulating chemical-protective suit
- Built-in outer chemical-resistant gloves and extra inner gloves
- Chemical-resistant boots with steel toe and shank
- *Disposable protective suit, gloves, and boots (worn outside the Level A suit to protect the expensive suit)
- *Long underwear (to absorb sweat)
- *Hard hat (under suit)

*** Optional**

Note: With SAR, the suit must be properly equipped with a pass-through air-line connection, called an air-line egress.

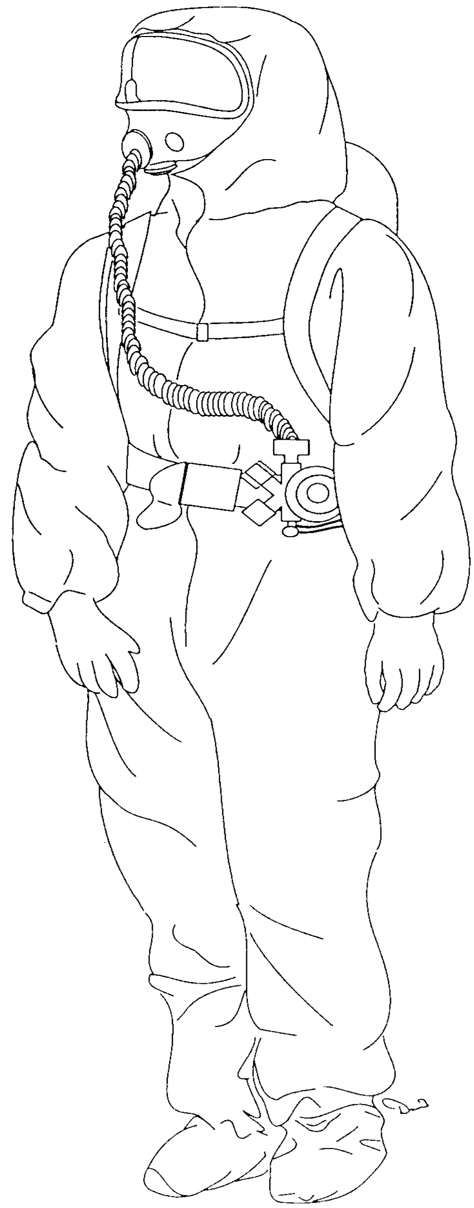
Level B

Level B is used when maximum respiratory protection, but a lesser degree of skin and eye protection is needed. **Level B is the minimum acceptable level for initial entry.**

Level B Consists Of :

- SCBA or SAR
- Hooded chemical-resistant clothing--**not** vapor-tight
- Inner and outer chemical-resistant gloves
- Outer chemical-resistant boots with steel toe and shank
- *Disposable protective suit and gloves (worn outside the Level B suit to protect the expensive suit and gloves)
- *Long underwear (to absorb sweat)
- *Boot covers: outer, chemical-resistant (disposable)
- *Hard hat
- *Face shield

*** Optional**



A Level B Suit that Covers the SCBA would be better

Level C

Level C provides less respiratory protection than A and B and less skin protection than A.
It may or may not provide the same skin protection as Level B depending on the type of B suit worn.

Use Level C When :

- the concentrations and types of airborne substances are known and you can safely use an APR.
- there is at least 19.5% oxygen in the air.
- direct contact with the hazardous substance will not harm the skin or be absorbed through the skin.

Level C Consists Of :

- An air-purifying respirator (NIOSH-approved)
- Hooded chemical-resistant clothing
- Inner and outer chemical-resistant gloves
- Outer chemical-resistant boots with steel toe and shank
- Outer, chemical-resistant disposable boot covers *
- Hard hat *
- Escape mask *
- Face shield *

*** Optional**

Level D

Level D does not provide respiratory protection nor skin protection. It is for people who work outside of the hazardous waste area. Level D protection is typically worn by workers involved with support activities such as equipment supply, maintenance, or off-site vehicle operation. Level D is similar to “typical work clothes” except for chemical-resistant boots with steel shank.

Level D can be worn when:

- the atmosphere contains no known hazards.
- the work will not involve getting chemicals on the skin or inhaling hazardous levels of any chemicals.

Level D consists of:

- Coveralls (work clothing)
- Chemical-resistant boots or shoes with steel toe and shank
- Hard hat*
- Gloves*
- Outer, chemical-resistant boots (disposable) *
- Safety glasses or chemical splash goggles*
- Face shield*

*** Optional**

Points to remember about Chemical Protective Clothing (CPC)

- CPC is effective only if it is properly selected, worn, and maintained. The site safety and health plan should include Standard Operating Procedures for CPC.

- Levels B and C may require taping of seams and other critical junctures; however adhesive tape may degrade the suit.

- Materials used to make most suits do not "breathe", causing rapid heat and moisture build-up and increasing discomfort. Extremes of cold and heat can often damage CPC.

- Always check the manufacturer's information about temperature damage.

- Most suits offer no fire protection and may increase the possibility of injury because they melt. Special fire retardant suits may be worn over your CPC, but this makes movement difficult. It also greatly increases the risk of heat stress.

- Chemicals can reduce the effectiveness of CPC by penetrating, degrading, or permeating the CPC.

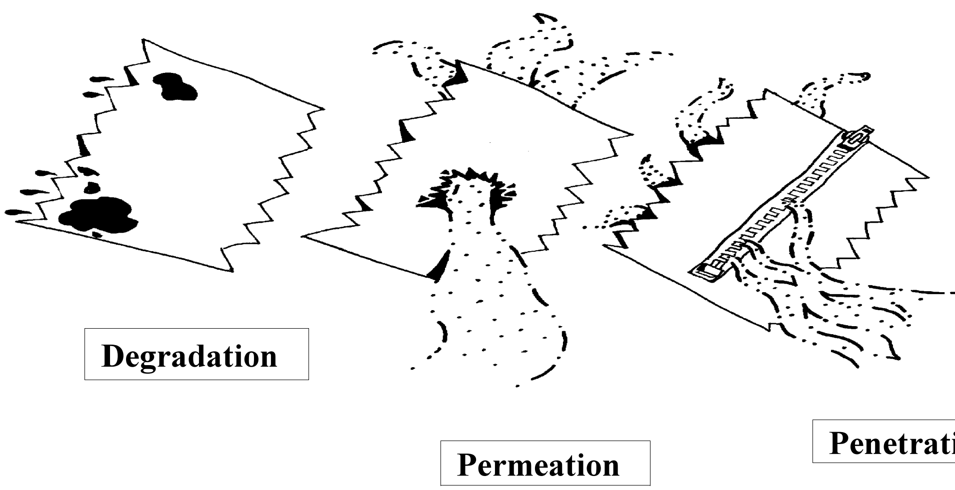
How Chemicals Can Damage CPC

Penetration Chemicals move through zippers, stitched seams, holes, tears, or other imperfections in the material.

Degradation The protective material melts, softens, or falls apart due to contact with a chemical.

Permeation A chemical soaks through a protective material on a molecular level (invisible). The rate of permeation depends on five major factors:

- Contact time
- Concentration
- Temperature
- Size of the contaminant molecules and pore size of the material
- Physical state (solid, liquid, gas) of the chemical contaminants



Chemical-protective clothing has limitations:

- Fully encapsulating suits make communication very difficult. It is important to establish other ways to communicate. Learn the alarm and hand signals used on your site. Two-way radios, portable radios, or radio with a microphone and speaker combination attached to the full-face respirator are recommended. Remember, all radios must be **intrinsically safe**.

- Most suits restrict movement and increase clumsiness, especially when climbing, working in tight areas, or using hand tools.

- Heat stroke is a serious threat. Watch for signs of dizziness, nausea, and lack of perspiration, especially at temperatures over 70°F.

- Disposable booties may be slippery. Use caution to prevent slips and falls.

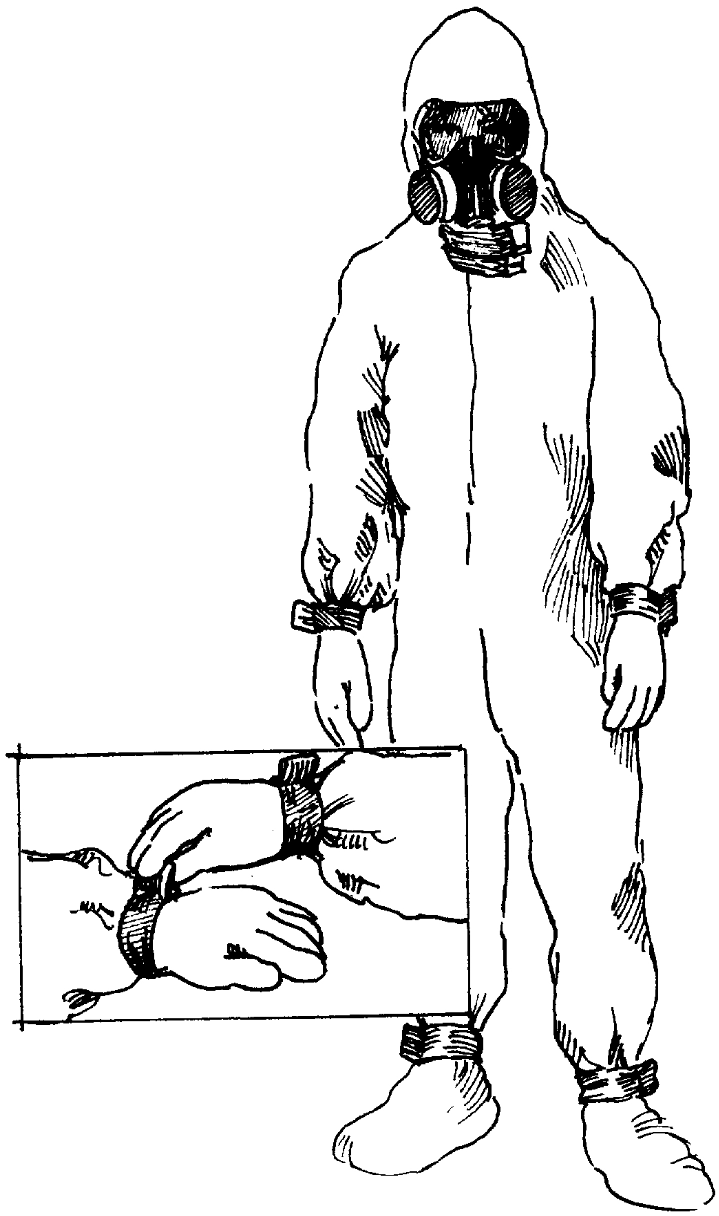
- Suit-to-boots and suit-to-glove joints should be taped. Fold the end of the tape back under to make a tab for easy removal. (See insert.) Use special care when removing tape. Adhesive tape can degrade suit material.

- Goggles and eye/face protection may become clouded due to moisture from breathing. When wearing Level A, you may want to keep a cloth inside the suit to wipe fog off the inside face shield.

- Kneeling can contaminate and tear the suit.

- Seams are weak points, especially in disposable suits. Be careful not to strain and split them. If this occurs, report the incident and follow the appropriate SOP.

- Use caution when suits are worn in potential fire areas. If fire occurs, get out of the area.



Inspecting, Maintaining, and Storing CPC

It is important to inspect CPC to detect any evidence of chemical damage. Instructions for inspection, maintenance, and storage should be in the site safety and health plan.

CPC should always be inspected when it is:

- received from the distributor
- issued to workers
- put into storage
- taken out of storage
- used for training
- used for work or an emergency response
- received from maintenance

An inspection checklist should be developed for each item. Factors to consider are:

- cuts, holes, tears, swelling, and abrasions in seams of fabric
- weakness in zipper or valve seals
- signs of contamination such as discolorations or visible stickiness
- signs of malfunctioning exhaust valves

Note: CPC may be contaminated even though it does not appear discolored

Proper maintenance and storage can prevent CPC problems and prolong the life of the equipment. SOPs should describe storage **before** the CPC is issued to the wearer and also post-use storage. Check manufacturer's data, as most CPC now has a shelf life.

Other Protective Clothing And Equipment

The situation determines the PPE needed. For example, chemical-resistant gloves, face shield/goggles, and apron can be used with Level D when no respiratory hazard is present but some risk of skin contact exists.

At sites, a number of operations could pose a substantial noise exposure requiring the use of hearing protection. When required, a hearing conservation program must be implemented (29 CFR 1926.52 and .101). The employer must provide a selection of hearing protection for you to chose from.

SUMMARY: CHEMICAL PROTECTIVE CLOTHING

Personal Protective Equipment includes respirators, chemical-resistant suits, steel-toed boots, gloves, hard hats, and hearing protection. PPE is required by OSHA regulations and protects workers from:

- chemical contact with skin and eyes
- noise
- respiratory hazards
- sharp objects underfoot
- falling objects

Suits can cause heat stress because air does not move through them. Heat stroke is a medical emergency requiring **immediate medical attention**.

Suits are made of many different kinds of materials, like butyl, neoprene, or polyethylene. No one material can stop all chemicals. All chemicals will eventually soak through the material (permeate), seams (penetrate), or melt the material (degrade).

Suits, respirators, several pairs of gloves, and chemical protective steel-toed boots are always worn together in an ensemble.

Levels of PPE

Level A is for gases that burn the skin or heavy spills of chemicals that can soak through the skin. It provides the most protection and includes:

- an SCBA (or supplied-air respirator with escape unit).
- a **gas-tight**, full-body chemical-protective suit with gloves and boots built in.

Level B is for high levels of gases or small spills of chemicals that can soak through the skin. It includes:

- an SCBA (or supplied-air with escape unit).
- a full-body chemical-protective suit that is **not** gas-tight
- gloves and boots

Level C is for known, low levels of gases, dusts, or spills of chemicals that can not soak through the skin. It includes:

- an air-purifying respirator (APR).
- hooded, chemical-resistant clothing.
- gloves and boots

PPE must be properly cared for, maintained, inspected and stored. Wearers should know the uses and limitations of PPE. Written programs about selection, care, and use of PPE should be included in or referenced in the safety and health plan.

BACKGROUND READING MATERIAL—PERSONAL PROTECTIVE EQUIPMENT

Occupational Safety and Heath Guidance Manual for Waste Sites
1989. (NIOSH # 85-115)

Chapter 8	Personal Protective Equipment, p. 1-24
Appendix D	Decontamination of Levels A, B, C

EPA's Standard Operating Safety Guides,
July 1988.

Part 5	Site Entry—Levels of Protection, p. 1-14
Part 7	Decontamination, p. 9-11 and Annexes

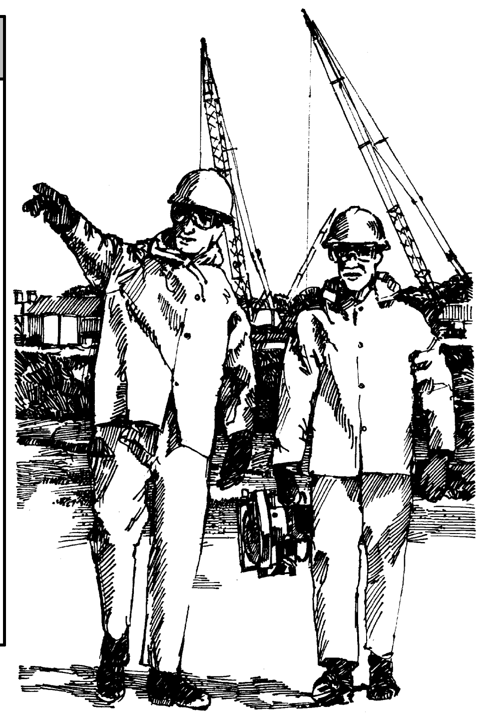
Hazardous Waste Operations and Emergency Response Standard
Federal Register, Final Rule. March 6, 1989. (29 CFR, 1926.65)
Personal Protective Equipment
Personal Protective Equipment Program
Engineering Controls, Work Practices and Personal Protective Equipment for Employee Protection

Ergonomic Criteria for the Selection of Chemical Protective Clothing, J.O. Stull, Washington D.C., Workplace Health Fund, 1991

CHAPTER 5: HAZARD CONTROL

Workers' exposure to hazards at a waste site is controlled through required engineering and administrative controls and personal protective equipment (PPE). Engineering controls are the most effective way to reduce workers' exposure. Personal protective equipment does not control the source of exposure but it does reduce the amount of substance reaching the body.

Chapter Objectives
After this training, you will be able to:
☞ Recognize what information is needed about the work site before cleanup work begins.
☞ Determine the most effective ways to control hazards on a job.
☞ Use the site-specific health and safety plan to obtain information.
☞ Use and understand terms like "site map," "buddy system," "communication systems," "work zones," and "site control" on the job.



CASE STUDY

Construction workers at a nuclear facility came across 20 barrels of waste they did not know about. When they tried to pry open the top hole of one of the barrels, it exploded. What went wrong?

The barrels had flammable solvents in them, and prying off the top made a spark that started the explosion. Before workers ever got on the site, safety personnel were supposed to figure out exactly what hazardous wastes were there and what the dangers are. This process of ***site characterization*** *lets workers know exactly what they might run into so they can protect themselves. In this chapter you will learn about site characterization to prevent this kind of problem.*

Site Characterization - 29 CFR 1926.65 (c)

Before cleanup begins on a hazardous waste site, site characterization must be done. Experts have to figure out:

- what chemicals are at the site
- where they are
- how much of each chemical is on site
- what the dangers are from the chemicals
- dangerous areas like mud pits or steep hills

Site characterization explains how to identify site hazards and to select worker protection methods. Conditions must be monitored after site characterization to detect changes.

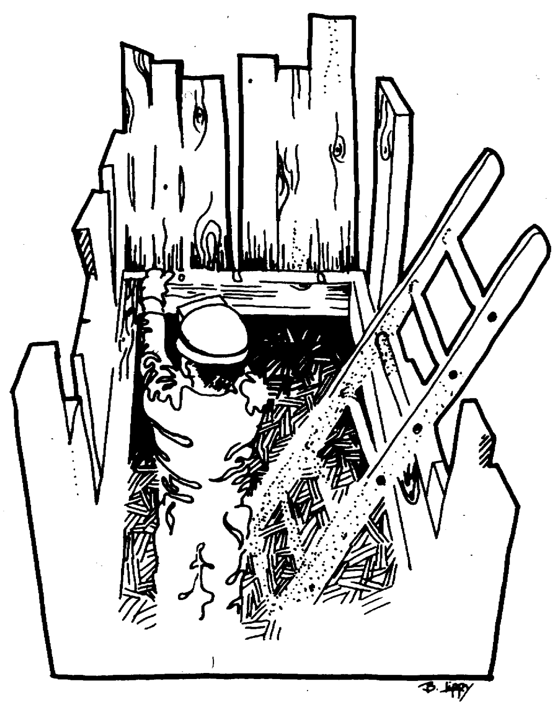
Part 1: Preliminary Evaluation--History and Background

Off-site information is obtained through interviews, existing records, perimeter observation, and manufacturer's material safety data sheets (MSDSs) or other documents regarding materials at the site. The preliminary site evaluation determines the level of protection to be worn by the entry team.

After the preliminary evaluation, the entry and back-up teams evaluate the site's specific characteristics to identify existing hazards and help select the appropriate engineering controls and personal protective equipment for the tasks to be performed. **Until concentration levels are known, Level B as a minimum is required.**

Part 2: Hazard Identification--A List of Dangers

Hazard identification documents all conditions that may cause death or serious harm, including those that may pose inhalation or skin absorption hazards that are immediately dangerous to life or health (IDLH). Hazards include: confined spaces (including trenches and low spots), potentially explosive or flammable situations, unknowns, buried drums and other construction hazards.



Source: Construction Health & Safety Manual
Construction Safety Association of Ontario

Part 3: Required Information

Before workers can enter a site, the following information must be obtained:

- Location and approximate size of the site
- Description of the tasks to be performed
- Time required to do the tasks
- Site description and accessibility by air and roads
- Safety and health hazards expected at the site
- Pathways for hazardous substance release
- Capabilities of emergency response teams
- Expected hazardous substances, their health hazards and chemical properties

Potential Site Hazards

Chemical	Biological
■ Acids ■ Bases (Caustics) ■ Solvents Chemical Hazards may be in the form of gases or vapors, liquids, solids, dusts and fumes	■ Bacteria—Salmonella ■ Parasite—Ticks, chiggers, mites ■ Plant—Poison ivy ■ Animal—Snakes, bears, rodents, wild dogs ■ Viruses–AIDS, hepatitis ■ Animal waste–hantavirus, psittacosis
Physical	**Psychological**
■ Radiation ■ Noise ■ Vibration ■ Electricity ■ Temperatures: heat and cold ■ Slips, trips, falls ■ Punctures: Needle sticks ■ Trenches and excavations ■ Confined spaces ■ Utilities (above and below ground) ■ Site run-off	■ Claustrophobia (fear of closed or narrow spaces) ■ Acrophobia (fear of heights) ■ Monotonous jobs ■ Disorientation in PPE ■ Fear of hazardous waste

Part 4: Suits and Respirators--Personal Protective Equipment

Personal protective equipment must be provided for workers engaged in initial site entry. If this initial survey cannot establish airborne concentrations, all employees must use a high level of protective gear called Level B or higher (see Chapter 4). Once further information on the hazards is available, the protective equipment will be reevaluated by the health and safety specialist and adjusted to be more or less stringent.

Part 5: Air Tests and Chemical Samples--Monitoring

Monitoring, see Chapter 8, must be conducted if the site evaluation shows the potential for IDLH conditions, ionizing radiation or if the evaluation provides insufficient information.

Monitoring must be conducted for:

- Hazardous levels of ionizing radiation with direct-reading instruments
- IDLH, combustible or explosive atmospheres, oxygen deficiency, and toxic substances with direct-reading instruments
- An ongoing program for site characterization

Part 6: Risk Identification--How Big Are the Dangers?

Risk identification is conducted once specific hazardous materials or conditions are identified. Employees must be informed of any risks, including:

- exposures exceeding required OSHA levels or those recommended by NIOSH or ACGIH (see definition section of the standard for "published exposure levels")
- IDLH concentrations
- potential sources of skin and eye irritation or absorption
- explosion and flammability risks
- oxygen deficiency or enrichment

Before work begins, each site worker must be told about the substances which may be present on site.

Part 7: Worker Notification

The employer must make hazard information available to all employees. Each employee must be informed about the hazards of each of the chemicals that they might be exposed to in doing their job.

NOTE: A model site characterization plan is found in Appendix C.

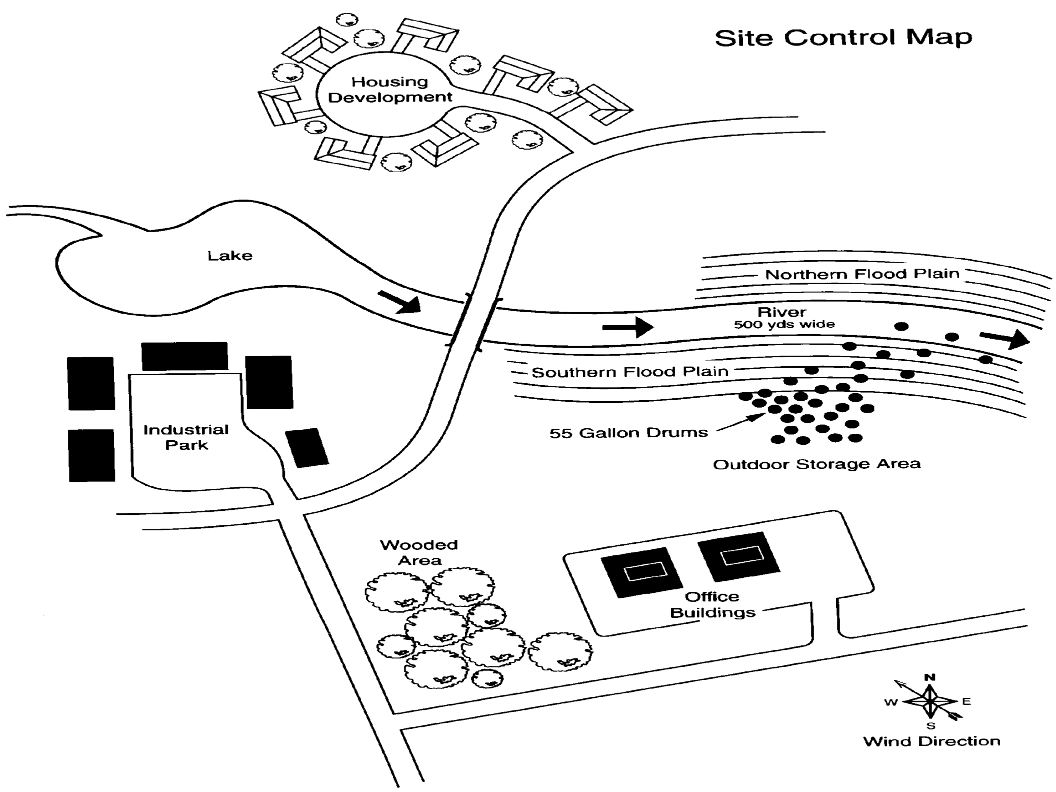
Site Control Program - 29 CFR 1926.65 (d)

The site control program establishes controls to reduce or prevent employee exposure before clean-up work begins. The Program must include:

- site maps
- work zones
- use of a "buddy system"
- site communications, including means for emergency alert
- standard operating procedures or safe work practices
- location of the nearest medical assistance

Site Maps

Site maps show the lay of the land, prevailing wind direction, drainage, and the location of buildings, containers, impoundments, pits, ponds, and tanks. Site maps are helpful for planning PPE use, assigning personnel to work zones, and identifying evacuation routes. A site map should be modified during site work to reflect changes in activities. Clear overlays can be used to help prevent information from cluttering the map.



Work Zones

Most hazardous waste sites have at least three work zones: hot, warm, and cold. These zones are used to control the spread of toxins and restrict the number of people in high-risk areas. The level of protective equipment needed is different for each zone. You may hear each zone called several different things.

Work Zones	Different Names	Potential for Hazardous Exposure
Hot Zone	**Exclusion Zone** **Danger Zone**	**High**
Warm Zone	**Contamination Reduction Zone** **Decontamination Zone**	**Medium**
Cold Zone	**Support Zone** **Clean Zone**	**Low/None**

The **Hot Zone** is the contaminated area. Activities performed in this area are:
- site characterization (e.g., mapping, photographing, sampling)
- installation of wells for ground water monitoring
- clean-up work such as drum movement and staging

The outer boundary of this zone is called the **hotline**. It must be clearly marked by lines or hazard tape or enclosed by physical barriers such as chains, fences, or ropes. Personnel working in this zone wear the highest level of PPE required on the site.

The **Warm Zone** is between the hot and cold zones, it contains the Contamination Reduction Corridor. Decontamination procedures take place in the warm zone. Decontamination may have two lines, a personnel line and a heavy equipment line if necessary. The personnel line is for workers. Tools and machinery are decontaminated in the heavy equipment line.

The **Contamination Control Line** is the boundary between the cold and the warm zone. The site safety officer, personnel decontamination station operator, and emergency response personnel are usually stationed here. Equipment, supplies and workers' rest areas, and contaminated water drainage containment is also located here.

Personnel in the **Cold Zone** should have no respiratory or skin exposure. The command post supervisor, project team leader, and support field team members are usually stationed in the cold zone. Location of this zone is chosen for accessibility (emergency vehicles), resources (power lines, water, shelter), visibility (line of sight to the Hot Zone), wind direction (upwind of the Hot Zone), and distance (as far from the highest hazard as practical).

A TYPICAL ARRANGEMENT OF THE THREE WORK ZONES

COLD ZONE

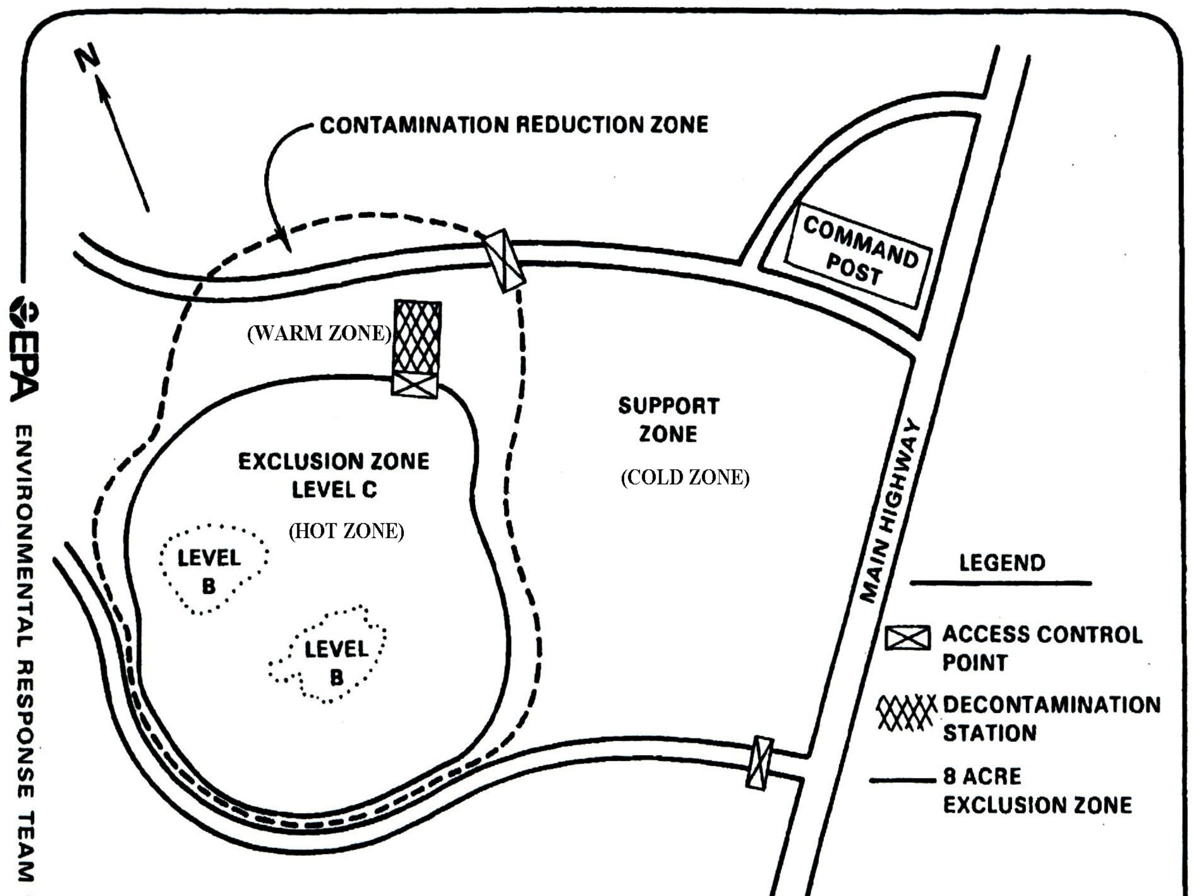


FIGURE 8-3 NEW HAMPSHIRE WASTE SITE

Buddy System

Hazardous waste workers must always work in teams of two or more. The "buddy system" requires pairs of workers to keep watch on each other's safety and health.

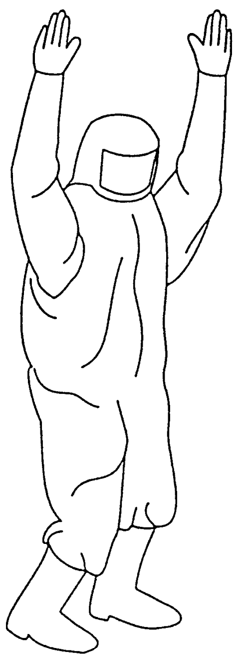
A buddy provides assistance, observes his/her partner for signs of chemical or heat exposure, periodically checks the partner's protective clothing, and notifies the command post supervisor if emergency help is needed.

Buddies should work in line-of-sight contact or communication with each other and the command post supervisor. Workers must make sure that hand signals are understood. Some common hand signals are shown on the following page.

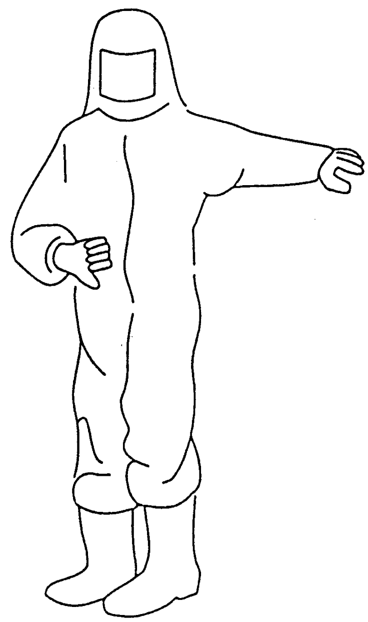
Communication Systems

Communication systems need to be established to alert team members to emergencies, pass along safety information (i.e., time available in air cylinder), initiate changes in work tasks, and maintain site control. Communication systems are internal (2-way radios, alarms, hand signals) and external (telephone, radio, etc.). Site specific training on warning systems is required.

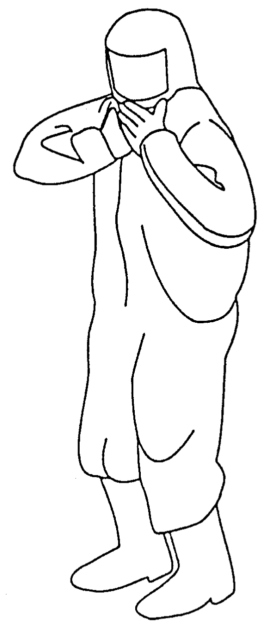
Common Hand Signals



In trouble; need help getting out of suit.



Task cannot be completed with remaining air



Out of air

*** Different sites may use different hand signals.**
*** Remember hand signals may vary**

Medical Assistance

Medical facilities must be identified before site characterization begins. The location of the nearest medical facility must be included in the site control plan. All employees must be informed of the location and how to notify the facility in the event of an emergency or when treatment is needed.

Safety and Health Program

The written safety and health program is required by OSHA 29 CFR 1926.65 (b) and must describe:

- an organizational structure for the safety program
- a comprehensive work plan
- a site-specific safety and health plan
- the safety and health training program
- the medical surveillance program
- the standard operating procedures for safety and health
- any connection between general and site-specific programs

The written program must identify, evaluate, and control safety and health hazards and provide for emergency response at hazardous waste sites. Copies of the written plan must be located at the work site and accessible to workers, contractors, sub-contractors, and government representatives

Organizational Structure

The organizational structure explains who reports to whom. It must describe lines of authority, responsibility, communication and the responsibilities of all site workers. The organizational structure must be in writing and taught during the site-specific training. The general supervisor has overall responsibility for clean-up activities. The safety and health supervisor develops the site safety and health plan and makes sure it is followed.

The organizational structure should be reviewed and updated as necessary. Site-specific training is needed whenever there is a change in work location or process.

Comprehensive Work Plan

The comprehensive work plan must include activities, logistics, and use of resources. The comprehensive work plan should be reviewed during the site-specific training. The work plan must include specific details about:

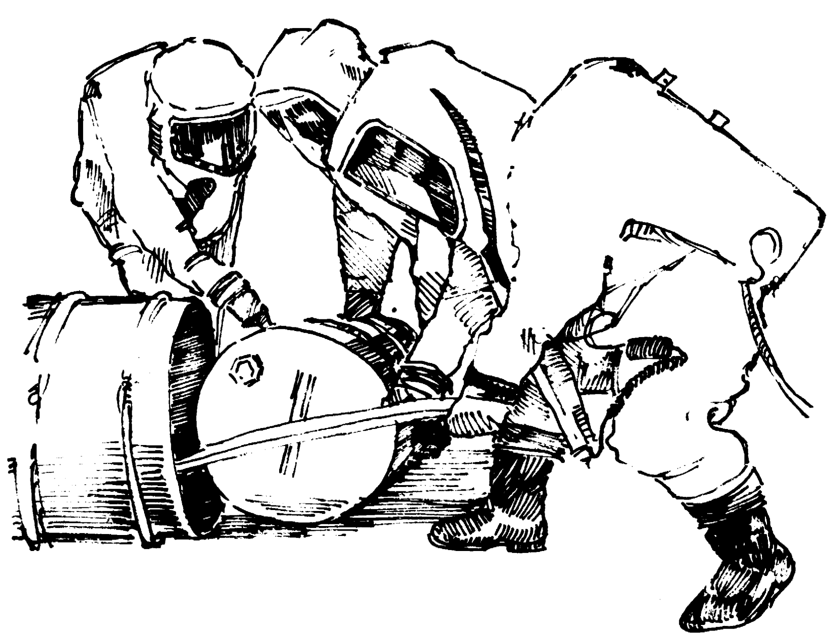
- the tasks to be done
- how they will be done
- who will do them
- what training will be needed
- what medical tests will be needed

Site-Specific Safety and Health Plan

The safety and health plan addresses the hazards during each phase of the work and the procedures required to protect employees. Each of the following topics must be covered:

- Safety and health hazard analysis for each task or operation
- Employee training
- Personal protective equipment
- Medical surveillance
- Air monitoring
- Site control
- Decontamination
- Emergency response
- Confined-space entry
- Spill-containment

The site-specific safety and health plan should be used as a planning guide before site work begins. It should also be used as a reference tool throughout the site work. When new information is obtained during site inspections, the plan should be updated.



STANDARD OPERATING PROCEDURES

Written standard operating procedures (SOPs) assure that site characterization is conducted according to a plan. SOPs are site-specific and generally cover:

- Use of specialized air-monitoring equipment
- Action to take if underground cables are discovered
- Communications with neighborhood groups and other organizations
- Lines of authority

These SOPs are outside the scope of this training program but would be covered in site-specific training.

For more information refer to Chapter 6 Work Practices.

WORKER TRAINING REQUIREMENTS

Under the OSHA standard 29 CFR 1926.65 (e), training must be provided for all employees working at a site who are exposed to hazardous substances, health hazards, or safety hazards. Supervisors and management responsible for the site must also receive training. Training should include in the following depending on the job description:

- Names of personnel and alternates
- Safety and health hazards present
- Use of personal protective equipment
- Safe work practices
- Engineering controls and equipment
- Medical surveillance, including recognition of symptoms which may indicate overexposure
- Decontamination
- Emergency response
- Confined-space entry
- Spill-containment program

General site workers must have a minimum of 40 hours of instruction and a minimum of three days site specific training under the direct supervision of a trained, experienced supervisor. Supervisors are required to complete the 40-hour general program, three site-specific training days, and an additional 8 hours of training designed for managers. Eight-hour refresher training is required every year for all site workers and supervisors. Employees who will assist with emergency response (ER) activities must receive site-specific ER training.

Workers who will be on site only occasionally for specific limited tasks, and who are unlikely to be exposed over the permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction and a minimum of one day of actual field experience under the direct supervision of a trained, experienced supervisor.

New Technologies

Unfortunately, worker protection often lags behind the development of new cleanup technologies.

The safety and health program must include a standard operating procedure (SOP) for introducing effective new technologies and equipment for improved worker protection.

New technologies must be evaluated before they are used on a large scale. Data from the manufacturer or supplier may be included in the evaluation. The process and all data must be available to OSHA.

Types of Hazard Control

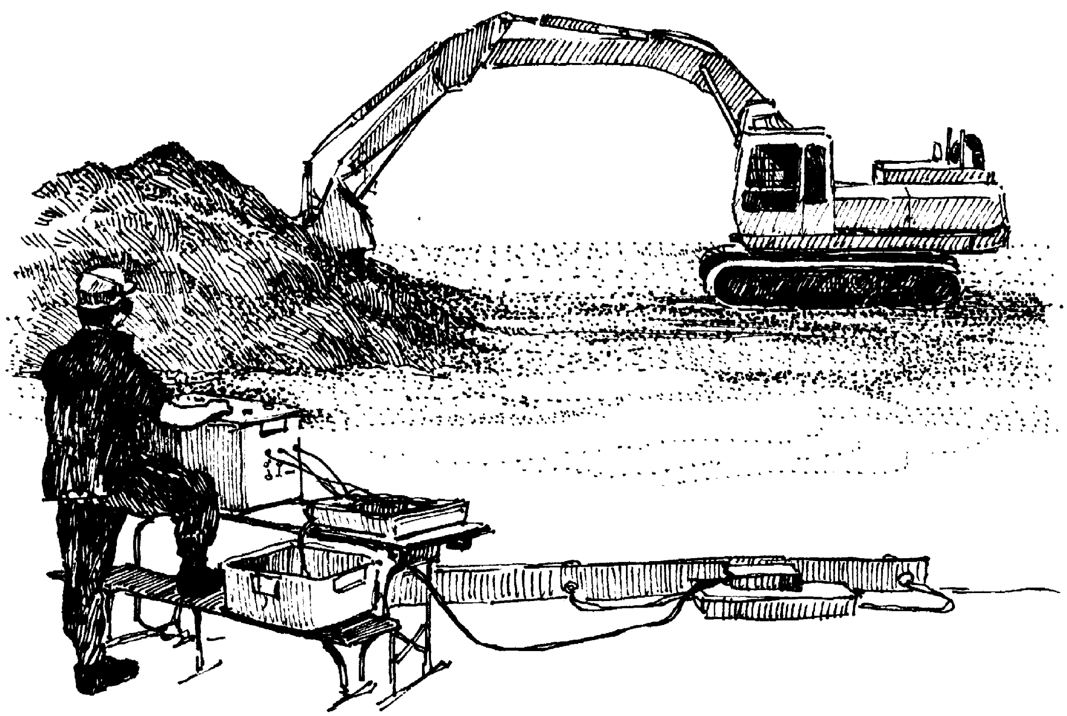
There are three basic approaches to hazard control at hazardous waste sites:

- Engineering controls prevent or remove the hazard to prevent exposure.
- Administrative controls are used to establish safe work practices and maintain low exposure levels.
- Personal protective equipment (PPE) prevents exposure from contacting the worker.

Engineering and administrative controls should always be used before PPE. Personal protective equipment is the last line of defense.

Engineering controls

Engineered systems such as remotely operated drum punchers, ventilation of confined spaces, and sealed cabs on earth moving equipments control the hazard to prevent exposure. Engineering controls are usually the most reliable way to control hazards.



Engineering Controls—This operator is avoiding exposures by operating the backhoe from a distance.

Administrative controls

Policies and practices must be written before the work begins to minimize employee exposure to hazards. They usually include a scheduling system or a system to limit time in a workspace or access to the space. Examples include industrial hygiene monitoring programs, medical surveillance programs, confined-space entry permits, lock-out procedures, and limiting exposure time.

Personal protective equipment

When the hazard cannot be removed, personal protective equipment (PPE) must be used to reduce employee exposures. Examples of personal protective equipment include: respirators, gloves, steel-toed boots, chemical-protective suits, and faceshields. PPE is discussed in Chapter 4.

All hazards at a site and methods which will be used to control them must be described in writing. The safety and health program must address on-site training.

SUMMARY: HAZARD CONTROL

Before you ever come on site, experts have done a lot of work to determine what chemicals and dangers are on site, how to do the cleanup work, and how to protect you--this is called site characterization.

There are three main ways to protect workers:
1) Engineering controls, like drum grapplers, that keep worker away from chemicals;
2) Administrative control-written plans such as standard operating procefures that control how workers interact with hazards.
3) Personal protective equipment like respirators and suits.

Most cleanup jobs will use all three methods.

The safety and health plan is a written document which includes site-specific information designed to identify, evaluate, and control exposures to hazards. The plan must include: chain of command on site, a comprehensive work plan, a site-specific safety and health plan, standard operating procedures (SOPs), safety and health training, a medical exam (surveillance) program, and any information necessary to link the overall company to the site-specific plan.

Hazard control procedures must be planned and put in place before workers enter the site, including a site map, work zones, buddy system, site communication (routine and emergency--hand signals, alarms, etc.), standard operating procedures, and identifying the nearest medical facility.

Everyone working on a site must receive at least 40 hours of off-site training before entering the site. Three days of on-site training are required before beginning work. Supervisors receive an additional 8 hours of off-site training. All employees attend an additional 8-hour refresher training course each year. Even workers not actively involved in cleanup operations must receive at least 24 hours of training plus one day of site specific training to be on site.

Every site is divided up into three areas: a hot zone (chemical cleanup), warm zone (decon), and cold zone (support/rescue) to keep chemicals from spreading outside of the work area. The zones are set up depending on monitoring results and the lay of the land.

BACKGROUND READING MATERIAL: HAZARD CONTROL

Hazardous Waste Operations and Emergency Response Standard, 29CFR1926.65

NIOSH Pocket Guide to Chemical Hazards. (June 1997). NIOSH, DHHS (NIOSH) Publication No. 97–140.

CHAPTER 6:
WORK PRACTICES

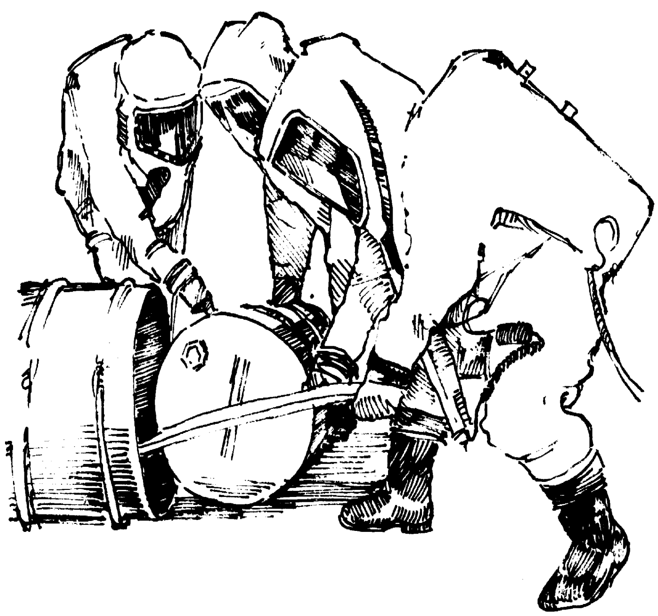
Safe work practices are vitally important to protect the workers' safety and health. Standard operating procedures (SOPs) are written instructions for safe work practices. Safe work practices can minimize exposure for workers, the environment, and nearby communities. Each site's SOP contains written instructions for safe work practices.

Chapter Objectives

After this training, you will be able to:

☞ Use special safe work methods (like using non-sparking tools with highly flammable chemicals).

☞ Recognize when unsafe methods are being used.



CASE STUDY

Workers were assigned to cut apart an empty 500-gallon tank. A mixture of benzene, xylene, and toluene had been drained out of the tank and there was no liquid inside. Everything was going fine when they were cutting on the outside of the tank, but once they cut through the metal there was a giant roar and flames shot out of the top of the tank. Luckily, it was a flash fire that went out quickly and no one was hurt. What happened?

Some of the chemicals were left on the inside of the tank, and caught fire. On a hazardous waste site some of the dangers are the same as on a regular construction job, and some of them are different. In this chapter you will learn about how to do the work safely to prevent this kind of problem.

How Are Hazardous Wastes Cleaned Up?

In the early days of hazardous waste cleanup, rusty barrels of chemicals were **put into new drums** and **buried** again in pits lined with plastic sheets. Tons of contaminated dirt were also dumped in these "safer" landfills. In 1984 EPA made it illegal to put hazardous waste in landfills (the "land ban"). Since that time, scientists have been coming up with new ways to treat hazardous waste or to clean up water or soil. Some methods include:

- ☞ **Free-product recovery.** Pump pools of waste out of the ground. The waste has to be treated with one of the methods below or the chemical may be purified and reused.

- ☞ **Filtration.** Filter out solid hazardous waste from water with sand beds or other filters. The waste has to be treated with one of the methods below.

- ☞ **Incineration. Burn** the hazardous waste in a high-temperature incinerator.

- ☞ **Solidification.** Mix waste with cement and ashes to turn it into a solid block that can be buried in a regular landfill.

- ☞ **Chemical decontamination.** Wash buildings or pipes with solvents to remove chemicals. The solvents have to be treated with one of the above methods.

- ☞ **Mechanical decontamination.** Scrape, blast, or grind buildings to remove chemicals. Sometimes special peel-off coatings are used. The dust has to be treated with one of the above methods.

- ☞ **Dismantling.** Cut machines or building components apart with saws, cutters, grinders, torches, explosives, or water jets. Dust must be treated with one of the above methods.

All of these methods can cause serious health and safety problems.

Standard Operating Procedures: SOPs

SOPs provide guidelines for routine operations and for emergency response. The following sections provide examples of SOPs for specific work practices at hazardous waste sites.

One important work practice for hazardous waste site workers is the Buddy System. Workers are organized into teams that are responsible for each another. Your "buddy" watches for signs of distress, heat exposure, and fatigue; and alerts others if help is needed.

SOPs are site-specific. They should detail safe work practices for the following hazardous waste site activities:

- Confined-space entry
- Lock-out
- Fire prevention
- Maintenance activity/hot-work permit
- Power tool use
- Soil excavation
- Equipment and vehicle operation
- Ladder and scaffolding use
- Loading and unloading procedures
- Drum and drum handling procedures
- Spill control
- Sanitation
- Respirator use and maintenance
- Site security

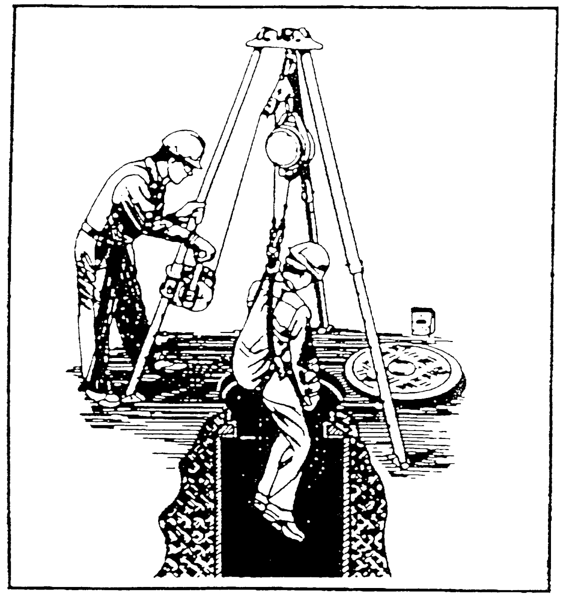
Confined-Space Entry Procedures

From 1980-1990, an average of 67 fatalities a year occurred in confined spaces. Many of the victims were attempting to rescue others. When NIOSH studied 70 incidents of confined space fatalities they found that none of the employees involved had a confined-space entry permit program in place.

Confined Spaces

According to OSHA, confined spaces have three defining properties:

- Limited ways to get in and out of the space.
- Not intended for continuous human occupancy.
- Large enough to fit a person.



Confined spaces found at hazardous waste sites include:

- ditches, culverts, and ravines
- excavations and trenches
- tank cars
- vaults
- sewer system with manhole entrance

Permit-Required Confined Spaces

Permit-required confined spaces (PRCS) are confined spaces with at least one additional hazards.

- Hazardous atmosphere (or the potential for one)
- Material that could engulf a person. The material could be stored in the space (for example, grain) or enter the space through pipes (such as water or chemicals)
- A shape (tapers, slopes or converges) that could trap or asphyxiate someone
- Any other recognized serious safety or health hazard

Other hazards which may exist in confined spaces include:
falling objects

- slip, trip and fall hazards Many confined spaces have slippery surfaces, sloping floors and converging walls.
- poor lighting
- extreme heat or cold
- electrical hazards
- biological hazards

Confined spaces do not always look dangerous. It may even be hard to recognize that a particular space is a confined space. For example, settling tanks and excavations are confined spaces even though they are open on top.

The potential hazards of confined spaces can become real hazards very quickly. Lack of ventilation can allow toxic gases/vapors to accumulate. Materials stored in the space or brought in through pipes can instantaneously engulf entrants. Energy sources which are not locked out can be turned on by people outside the space. All potential hazards must be evaluated and controlled before work inside the space begins.

Monitoring the air in a Confined Space

90% of all confined space deaths are due to atmospheric hazards. The trouble is you cannot see atmospheric (air) hazards. You can not see when there is too little oxygen or when there is too much oxygen in the air. You can not see toxic or flammable gases/vapors that accumulate in confined spaces (except for very rare cases).

Oxygen Deficiency

A common hazard in confined space is oxygen deficiency (less than 19.5% Oxygen).

What Causes Oxygen Deficiency?

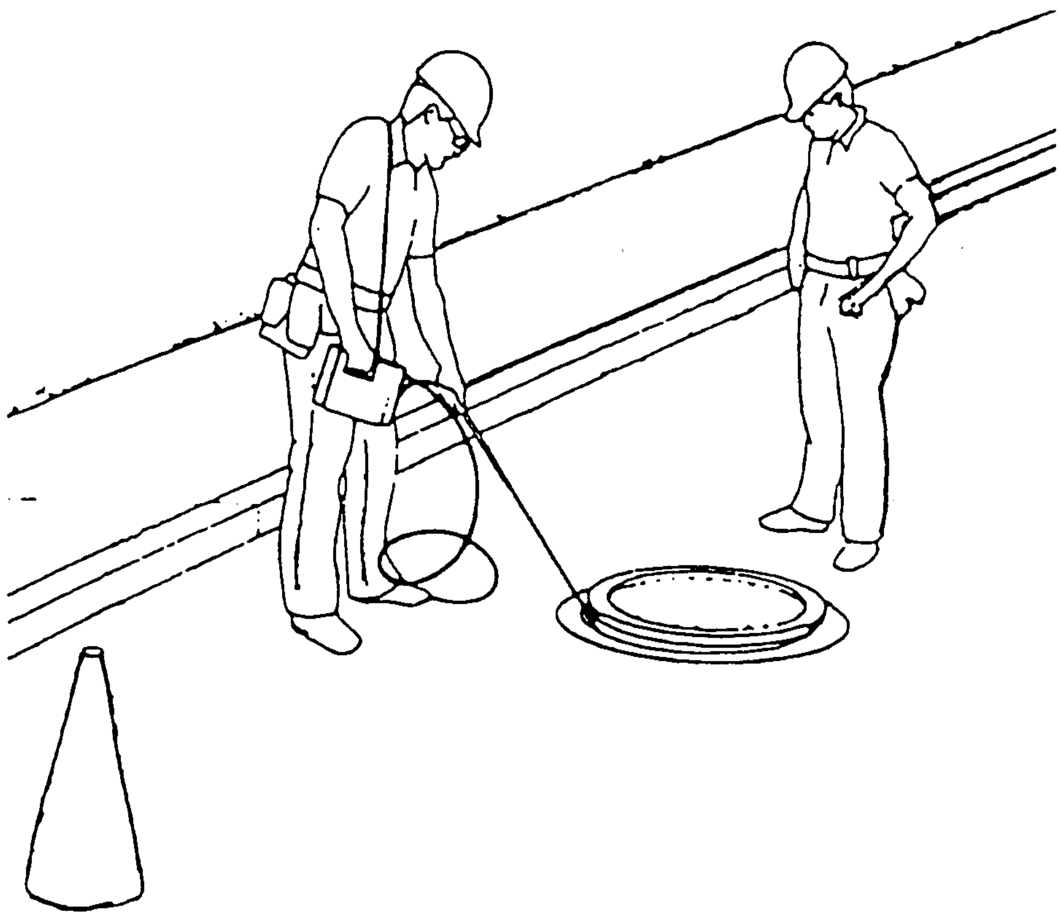
- lack of ventilation
- other gases in the confined space can displace the oxygen in the air
- confined space work activities such as welding and burning can "use up" oxygen
- chemical reactions such as rusting or even the drying of certain paints and cements can also "use up" the oxygen

Note: Using welding or medical oxygen to "ventilate" a space can cause oxygen levels to become dangerously high (greater than 23%).

Remember:

- Always monitor the air to find the oxygen content of the confined space.
- Do not operate heaters or motors in confined spaces
- Rust, drying paint, cement or caulking can increase the chances of oxygen deficiency
- Welding or burning inside confined spaces present major hazards and require special precautions as well as special hot work permits

All confined space SOP's should be in compliance with OSHA's General Industry Permit-Required Confined Spaces Standard (29 CFR 1910.146) This should be the case even if the space is not a permit-required confined space.



Always monitor the inside of a confined space from outside the space. Collect the air sampling through a sampling probe inserted into the space.

Confined Space Permits must include:

- The space that is going to be entered
- Why the space needs to be entered (description of the work to be done)
- The date, length of time the permit is good for
- Names and/or identification of the authorized entrants
- Names of the attendants
- Name of the entry supervisor. A space for the initials /signature of the supervisor who originally authorized entry
- The hazards of the space
- How the space will be isolated (for example, purged, ventilated, inerted, blanked and blinded, locked-out), and how hazards will be eliminated or controlled
- The conditions that must exist for entry to begin
- Air monitoring results and the names/initials of the people who did the monitoring. Permit must also show when the tests were done. (For information on monitoring procedures and equipment)
- Who to call for emergencies and rescue and how to contact them
- How entrants and attendants will communicate with each other
- All the equipment which has to be provided to comply with the standard. This includes alarms and monitoring, personal protective, communication, and rescue equipment
- Any other information which is needed to ensure worker safety during confined space entry
- Other permits, such as hot work permits, which are needed for the work to be done

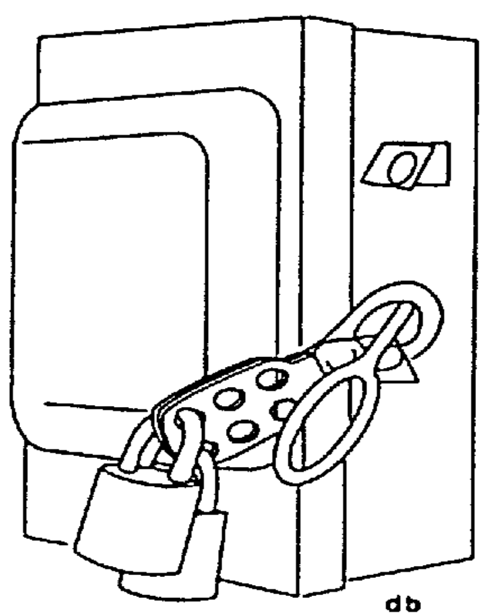
LOCK-OUT PROCEDURES

Electrical power, mechanical equipment, pipes and valves must be locked-out to prevent operation during repair or cleaning. It is not enough to just turn off an electrical switch, you must lock-out energy sources; otherwise equipment can be started up by someone unaware of the work being done. When locking out steam pipes you must release the pressure before unbolting and separating pipes.

✔ ***Know the site lock-out procedure before any operation is attempted.***

✔ ***Never assume a machine, circuit, or pipe is locked out just because it should be.***

☞ ***When in doubt, lock it out!***



LOCKED OUT

This tag must always be used and completely filled out before it is used

DO NOT START!
DO NOT OPEN!
DO NOT CLOSE!
DO NOT ENERGIZE!
DO NOT OPERATE!

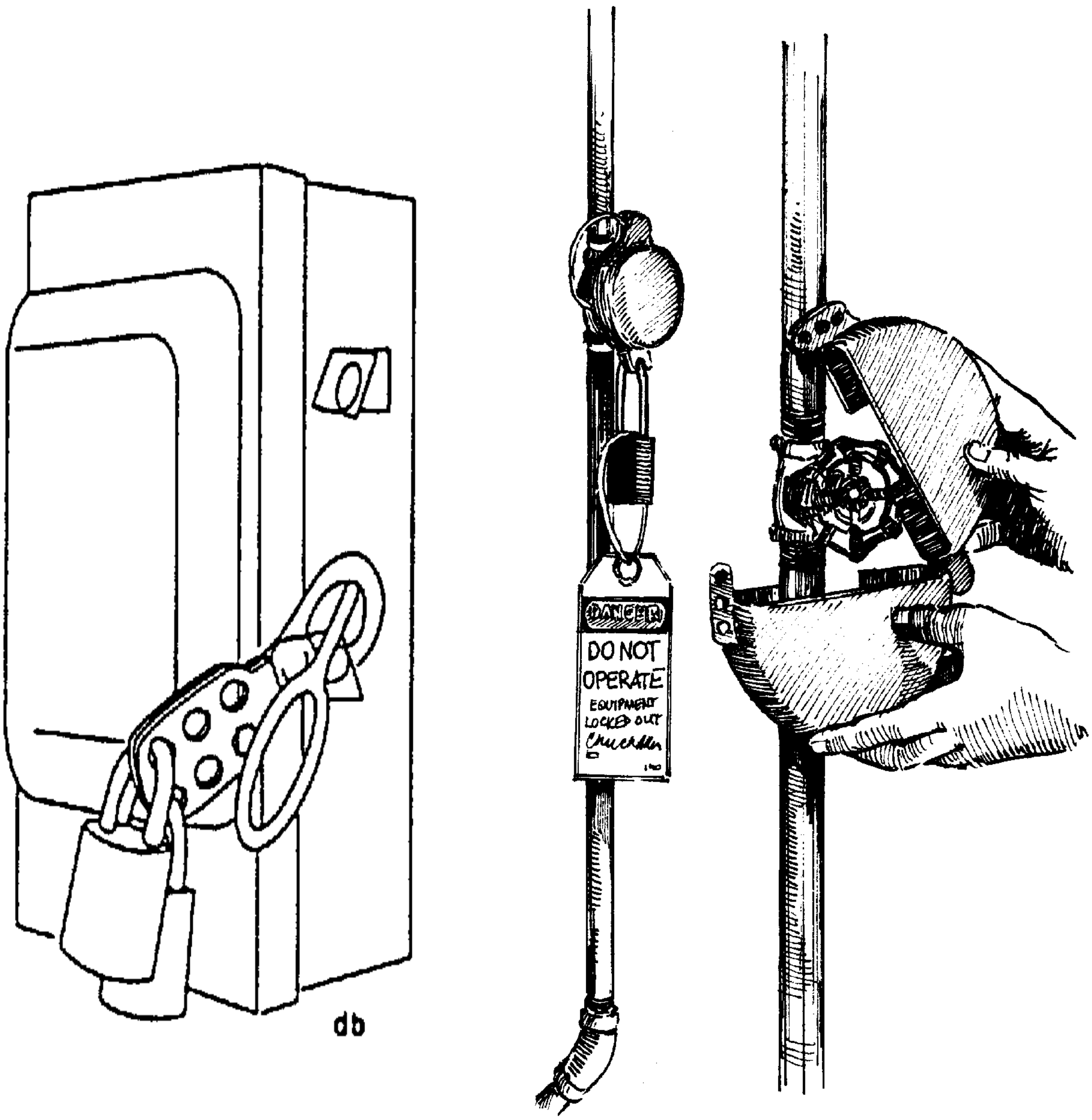
1. Employee Name: ______________________
2. Date Lock Placed:______________________
3. Time Lock Placed:_____________________
4. Was starter pushed to determine equipment to be worked on did de-energize? Yes No
5. Has the undersigned verified that the correct main breaker has been locked out? Yes No
6. Has the equipment been isolated from other energy systems such as hydraulic or pneumatic which could endanger others?
   Yes No

Comments: ______________________________
____

Lock-out tags should be placed on all locked-out equipment.

Basic Lock-out/Tag-out steps

- The first person to work on a piece of equipment turns the power off at the switch and at the electrical box. Each worker then installs his or her own personal lock to a lock-out clamp that prevents the arm from moving into the on position. To make sure the switch is off, someone has to turn on the switch to verify it was actually de-energized.
- When the job is done each person removes his/her own lock. After the last lock and clamp are removed, the warning tag can be removed and the equipment re-energized.
- Each lock must be removed only by the person who installed it.



Lock-Out Devices

FIRE PREVENTION AND CONTROL

Fire and explosions are serious waste site hazards. Flammable materials, incompatible and unstable chemicals, and hot work can serve as the ignition source that triggers a fire or explosion.

Constant attention must be given to **preventing** fires and explosions. **Prevention is everyone's responsibility.**

To prevent and control fires your employers should:

- Maintain supplies of fire-extinguishing media (foam, water, powder)
- Locate fire-fighting equipment in strategic areas
- Train fire brigade crews and allow them adequate practice time
- Conduct fire drills and site evacuations
- Conduct frequent fire safety inspections
- Inspect and maintain fire-suppression equipment
- Post evacuation routes
- Train employees in hazard recognition
- Store and handle compressed gases and explosive/flammable chemicals properly

To help prevent fires:

- Provide and use **non-sparking tools**
- Use only **intrinsically safe** radios, electronic and electrical equipment and power tools
- Follow other safety rules to reduce the possibility of fire

EQUIPMENT MAINTENANCE AND HOT-WORK PERMIT

Equipment Maintenance

Equipment maintenance is an ongoing process at any hazardous waste site. Before equipment receives maintenance or service, it should be removed from the Hot Zone, decontaminated and taken to the Cold Zone for repairs.
Unless:

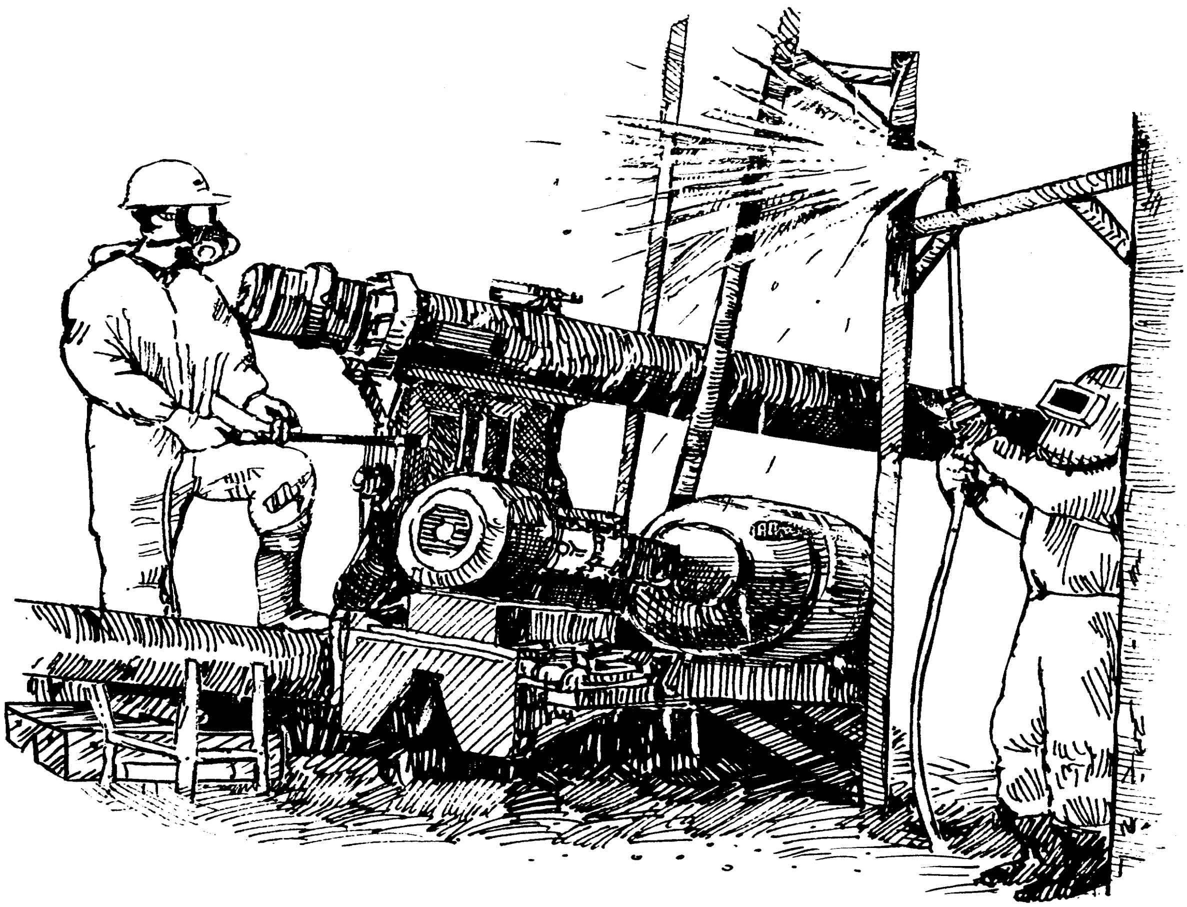
- repairs are minor
- equipment cannot be moved by any method or without causing additional damage

If repairs must be done in the Hot Zone the mechanics must be qualified for entry and must wear required PPE.

In the Cold Zone equipment should be repaired away from site activity, traffic and flammable and combustible materials, especially if welding, cutting, or heating is needed. Equipment, blades, end-loader buckets, dump bodies, and similar equipment must be either fully lowered or blocked when being repaired, as described in OSHA's Subpart O (motor vehicles, mechanized equipment). 1926.600 (a)(3)(I). All controls must be in a neutral position, with the motor stopped and brakes set, unless the work requires otherwise.

Hot-Work Permit

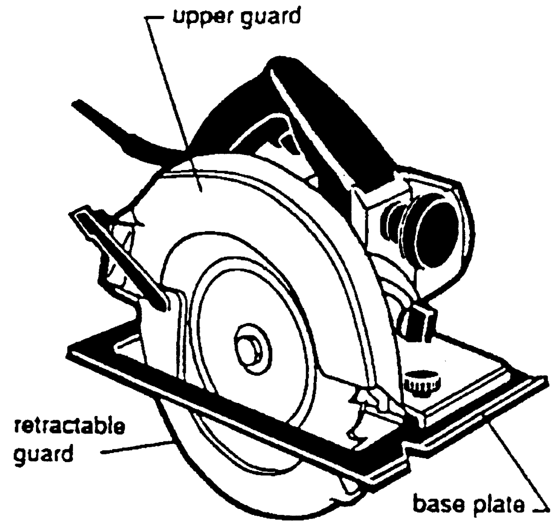
Cutting, welding, and grinding are common activities at hazardous waste sites. Before welding begins, remove any extra air cylinders or other cylinders from the area to prevent fires. Welding on equipment or vessels that may contain traces of heavy metals or chlorinated solvents must be done with adequate ventilation and personal protective equipment. OSHA's Subpart J--Welding and Cutting, provides minimum safety requirements for all cutting and welding activities. Hot-work SOPs should include a permit system.



The fire-watch buddy system during cutting.

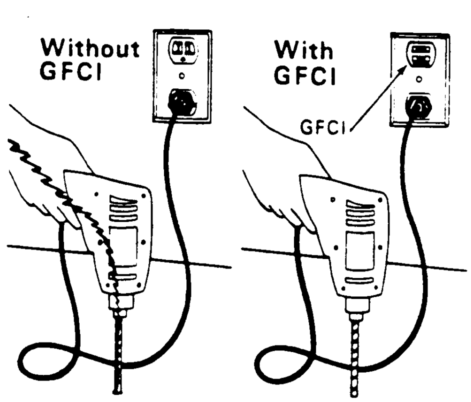
Power Tool Use

Improperly used or maintained power tools can cause electrical shocks, fires, and explosions. On hazardous waste sites power tools can spread contamination.



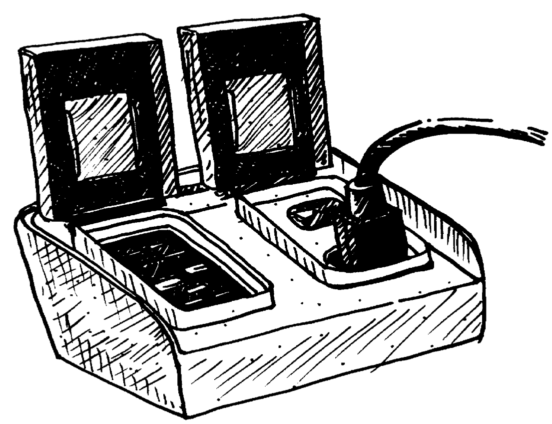
The following general guidelines should be incorporated into site-specific SOP's for power tool use:

- Use ground fault circuit interrupter (GFCI) protection when working with power tools



- Use non-sparking explosion-proof hand tools near flammable and combustible material
- Use specially-designed explosion-proof power tools (called intrinsically safe) near flammable and combustible material
- Keep guards and other safety devices in place and operational at all times
- All electric power tools must be (approved) double insulated or grounded
- All tools must be inspected before use
- Decontaminate tools after each use, and return them to proper storage

Every construction site must have an *Assured Equipment Grounding Conductor Program* for cords and receptacles that are not part of the building. This includes:



- A written program
- A competent person to run the program
- Inspections of all cords, plugs, and receptacles before each day's use
- Continuity tests and polarity test every 3 months <u>and</u> after repairs
- Records of tests kept on site

SOIL EXCAVATION PLAN

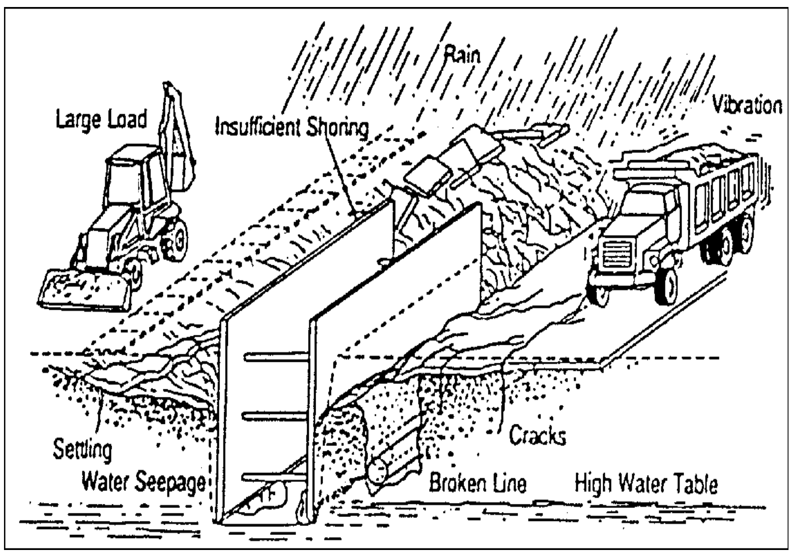
At a minimum, excavation SOPs must comply with all OSHA requirements listed in 1926 Subpart P--Excavations.

These include:

- Excavations 5 feet or more deep (in stable soil) must be shored or sloped
- Excavations 4 feet or more in depth must have a stairway, ramp, ladder or other safe ways to exit to prevent more than 25 feet in lateral travel for employees
- Locations of utility lines must be determined before excavation begin
- Air monitoring must be conducted if oxygen deficient or hazardous atmospheres exist or could exist in an excavation that is more than 4 feet deep

The soil excavation SOP needs to address these questions.

- What is the contaminate? What are the physical properties?
- How much has to be removed?
- What equipment is needed for excavating and loading soil?
- Will personal monitoring be necessary?
- What PPE is required?



Factors that influence trench stability

Source: Construction Health & Safety Manual,

Construction Safety Association of Ontario

The SOPs should contain these or similar directions

- Excavate clean areas first, then dirty areas to avoid spread of contamination on machinery

- Set up soil loading and stockpile area with:
  - bermed, plastic-lined area to hold soil
  - a method to cover the pile in case of rain
  - cat walk and platforms from which to work when lining and tarping trucks

- Take soil samples when excavation reaches required depth to determine if the excavation is clean

- Decontaminate all equipment that was used for removal and will be used for restoration

More than 5,000 workers are seriously injured

and

100 die every year in slides and cave-ins.

Equipment and Vehicle Operation

Even though a worker may not operate equipment or vehicles, the presence of heavy equipment and vehicles affects everyone on a hazardous waste site.

Keep the following safety precautions in mind:

- All equipment in the Hot Zone must stay there until it is thoroughly decontaminated
- Equipment and vehicle operators who wear protective clothing and respirators may not be able to hear or see as well as you would expect, so the reactions may be slower
- Remember never to work or stand underneath loads handled by lifting or digging equipment
- If you are working in an excavation, pay close attention to any nearby vehicles or equipment
- Workers near or around vehicles must be given highly visible working vests. This is especially true on hazardous waste sites where an operator's vision may be impaired
- Always check vehicles entering and/or exiting the site for leaks and spills. Direct vehicles to decontamination if needed

LADDERS

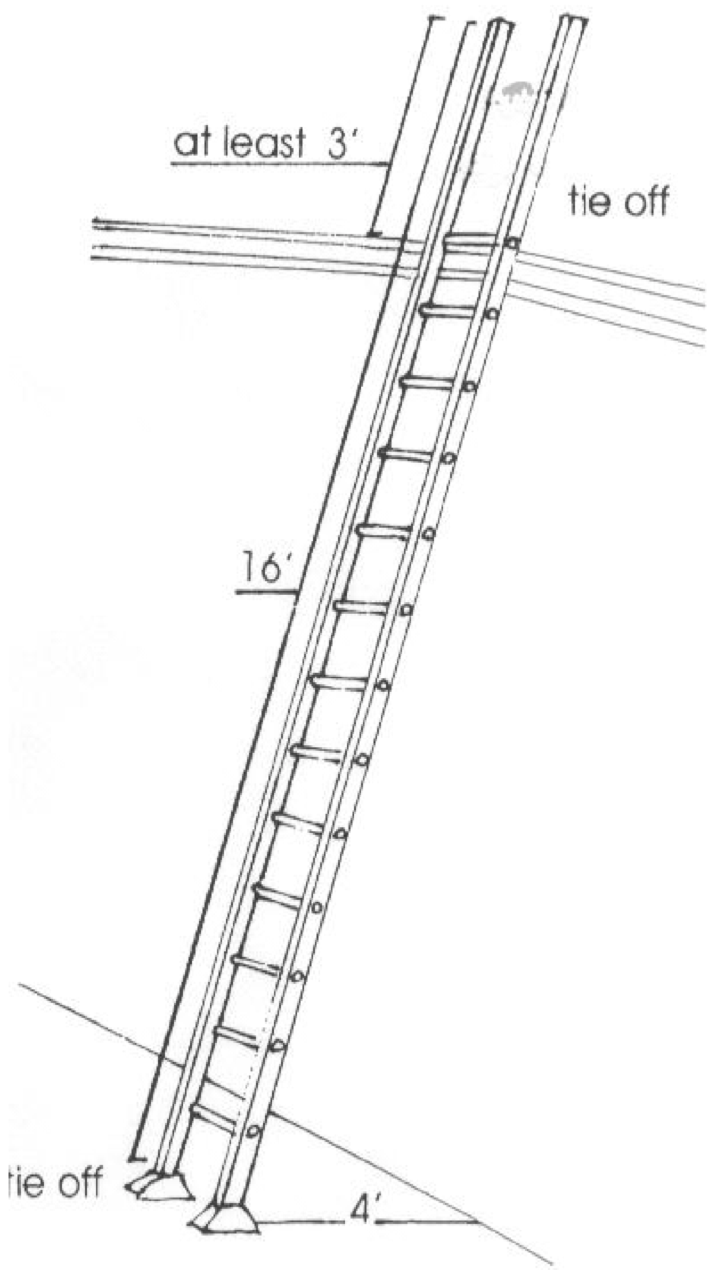
Ladders must not be moved, shifted or extended while occupied.

At a minimum ladders must comply with the requirements of OSHA's 1926 Subpart X Stairways and Ladders.

You may have to take extra care when using ladders while wearing PPE. Restricted motion and visibility make these regulations especially important.

1926.1053 Ladders

- Ladders must have non-conductive side rails if used around energized electrical equipment
- You must hold the ladder with at least one hand when going up or down the ladder
- You must not carry any object or load which could obstruct or hamper a climb, or cause loss of balance
- Portable ladders must be capable of supporting at least 4 times the intended load

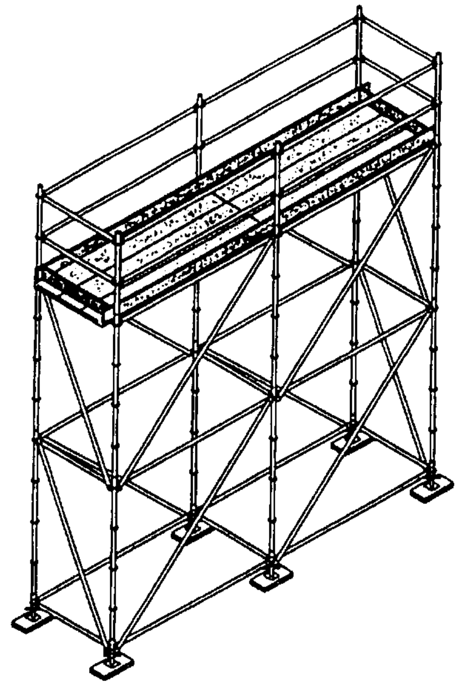


The horizontal distance should be ¼ the length of the ladder.

Ladder must extend 36 inches above a landing platform.

Scaffolds

The five most serious scaffold hazards are:



- falls
- unsafe access
- struck by falling objects
- electrocution when scaffold components become energized or contact live lines
- scaffold collapse

At a minimum, the use of scaffolds must be in compliance with OSHA's Subpart L (1926.450-454). Working on, erecting or dismantling scaffolds in a hazardous atmosphere or while wearing PPE will require extra caution.

The following are a few of the basic scaffold safety requirements which must be met:

- Scaffolds must be able to support their own weight plus at least **FOUR** times the maximum intended load
- Personal falls arrest systems or guardrails are required on scaffolds when workers are exposed to falls above 10 feet
- Supported scaffolds with a base to height ratio above 4:1 must be restrained by guying, tying, bracing, etc. Supported scaffolds must be plumbed and braced
- Supported scaffolds must rest on base plates, and either mud sills or other firm foundations
- Scaffold platforms must be fully planked or decked. Planks and decking must meet minimum requirements

Scaffold Training Requirements - 1926.454

- Everyone who works on a scaffold must be trained to be able to recognize and control the hazards of working on scaffolds
- Anyone who erects, dismantles, moves, repairs, or inspects scaffolds must be trained in those procedures

Lifting And Loading

To reduce musculoskeletal risks of lifting, loading and other manual materials handling:

- Use carts, dollies, hoists, and pulleys whenever possible. Repetitive lifting of even light loads can cause damage to the spine. Get help when lifting heavy and awkwardly shaped loads
- If the load is compact enough to fit between your knees, lift with a squat lift keeping the object as close to your body as possible
- Store materials at waist height to avoid excessive bending
- Try keeping the distance of the lift between knuckle and shoulder height. Lifting above the shoulders places extra stress on the spine and back muscles as well as the neck, shoulders and arms
- Never twist and lift at the same time. Avoid uneven one-sided lifting
- Do not try to catch falling objects
- Pushing is less stressful to your back, arms, and shoulders than pulling. It also gives you the advantage of your own weight
- Get adequate rest

DRUMS AND DRUM HANDLING

Even if your job does not involve drum handling, you may be exposed to large numbers of drums containing known or unknown chemicals.

If you use the chart below, you can figure out what type of material is supposed to be in any drum you come across.

TYPE OF DRUM	CONSTRUCTION	CONTENT
CLOSED-TOP*	Metal (unlined)	Non-corrosive products in liquid form
CLOSED-TOP	Plastic or composite (plastic inside metal or lined cardboard)	Corrosive liquids (acids or bases)
OPEN-TOP	Metal (unlined)	Non-corrosive solids or sludges
OPEN-TOP**	Plastic (lined)	Corrosive solids or sludges
SPECIAL	Stainless steel, nickel and Monel ™	Extremely hazardous materials
OVERPACK--LARGE OUTSIDE DRUM WITH A LEAKING DRUM INSIDE	Metal or plastic	Any leaking drums listed above
CLOSED-TOP DRUMS WITH FITTINGS	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 materials

*Closed-top drums are sealed and have small openings (bungs) in the top.

** Open-top drums have removable lids and may or may not have bungs.

Drum Inspections

Unidentified drums can be very dangerous and should be sampled and handled by experts. If you discover a drum, report it immediately to your supervisor. Assume that a drum or container is hazardous until tested. Do not rely on outdated or questionable drum markings or labels alone to identify hazards.

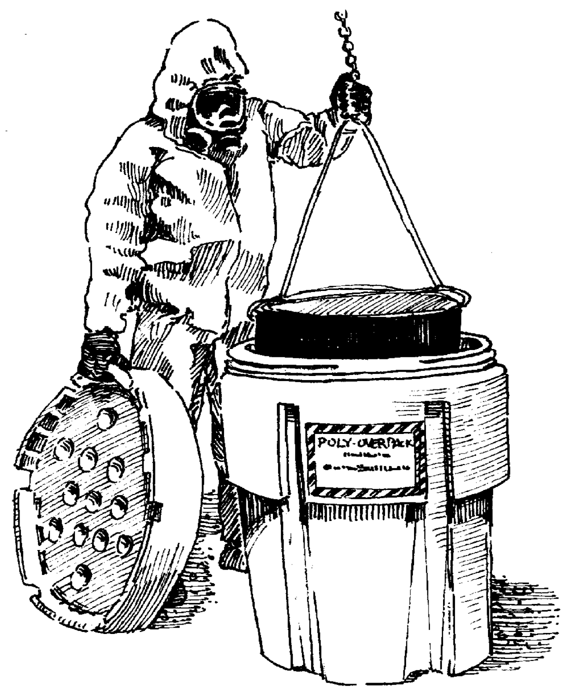
Special instruments or probes should be used to detect buried drums. Drums which may contain radioactive wastes must not be handled until specially trained personnel can assess the hazards.

Routine drum inspections, daily or according to the site SOP, should be conducted to look for:

- leaking
- swelling or bulging
- rust or other evidence of deterioration
- exterior corrosion or crystallization

Report these or other identified conditions to the supervisor.

Moving Drums



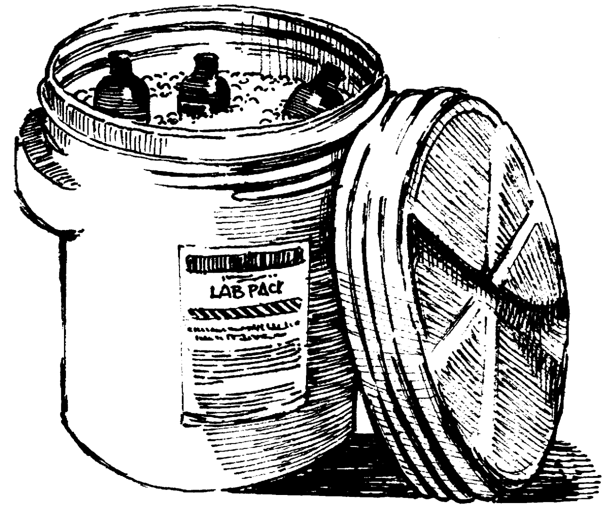
Only workers trained to do so should move drums. They should use remote handling equipment whenever possible. Fire-extinguishing equipment must be on hand and ready to use. They will move the contents of deteriorated drums to clean drums when they cannot fix the drums. The clean container must meet DOT, OSHA, and EPA requirements.

Explosives or Shock-Sensitive Wastes

OSHA lists minimum special handling precautions which must be taken if a container is known or suspected of holding shock-sensitive wastes (29CFR1926.65(j)(5). You should assume that a container of packaged laboratory wastes contains shock-sensitive or explosive material until all contents have been identified.

Lab Packs

OSHA also lists special requirements for handling drums with mixed wastes from laboratories--called lab packs (1926.65 (j) (6).



These include:

- Only persons with specialized knowledge can open lab packs
- Unless the contents are otherwise identified, handle as shock-sensitive waste (especially if you see crystals on any container)

Drum Staging

Staging means placing drums alongside similar containers. This is one step toward remedial action. For staging drums are placed no more than 2 wide with an aisle between. This allows access to all drums without standing on, or leaning over, drums.

Staging areas may include:
- Drum opening and sampling
- Holding materials until test results come back
- bulking or mixing compatible materials
- loading and shipping

The number of staging areas should be kept to a minimum. There must be adequate access and exit routes must be maintained at all times.

Drum Storage

Drums should be stored by compatible chemical groups to prevent hazardous reactions and errors in shipping.

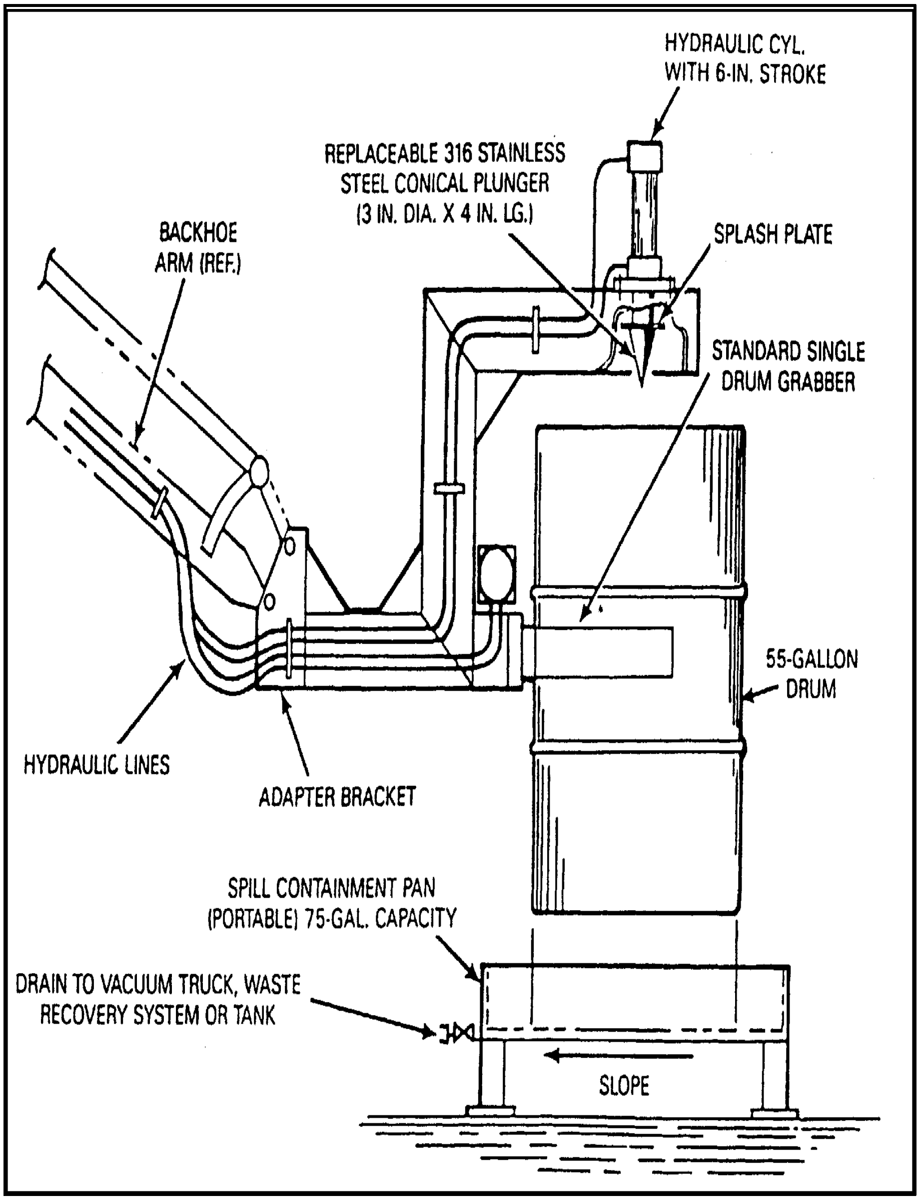
If drums are stored on pallets:
- Store only compatible substances on the same or adjacent pallets Use only intact pallets without broken or damaged boards
- Set drums squarely on pallets and band drums together if possible
- Place drums with labels and numbers facing outward
- For storage, drums may be placed no more than 2 high and 2 wide with an aisle in between

Drum Opening Procedures

Opening drums puts workers at serious risk. The work should be done by remote drum grapplers if possible. Specific procedures are required in areas where drums or containers are being opened. OSHA 29 CFR1926.65(n)(7) has special requirements.

Anyone who opens drums must use non-sparking and intrinsically-safe tools. Grounding may be necessary. Never stand on drums or a containers.

Backhoe-mounted drum puncture device.



Drum Sampling Precautions

Drum sampling is usually carried out by trained engineers or technicians. It is useful to know the correct procedures which must be included in the safety and health plan.

If any of the following conditions are present, the drum should not be sampled until special precautions are taken.

- A bulging top warns of pressure build up within the drum
- Damaged or dented drum could also mean a build-up of pressure
- Vapor or mist coming from the top of the drum, usually near the bung hole
- Obvious leak

These sampling safe work practices should be included in the SOP:

- Drum tops should be covered with plastic sheeting to avoid worker contact
- Never stand on drums, use ladders and platforms to reach stacked drums
- Do not lean over drums to reach the one being sampled
- Dispose of, or decontaminate sampling equipment according to the sampling plan

Spill Control

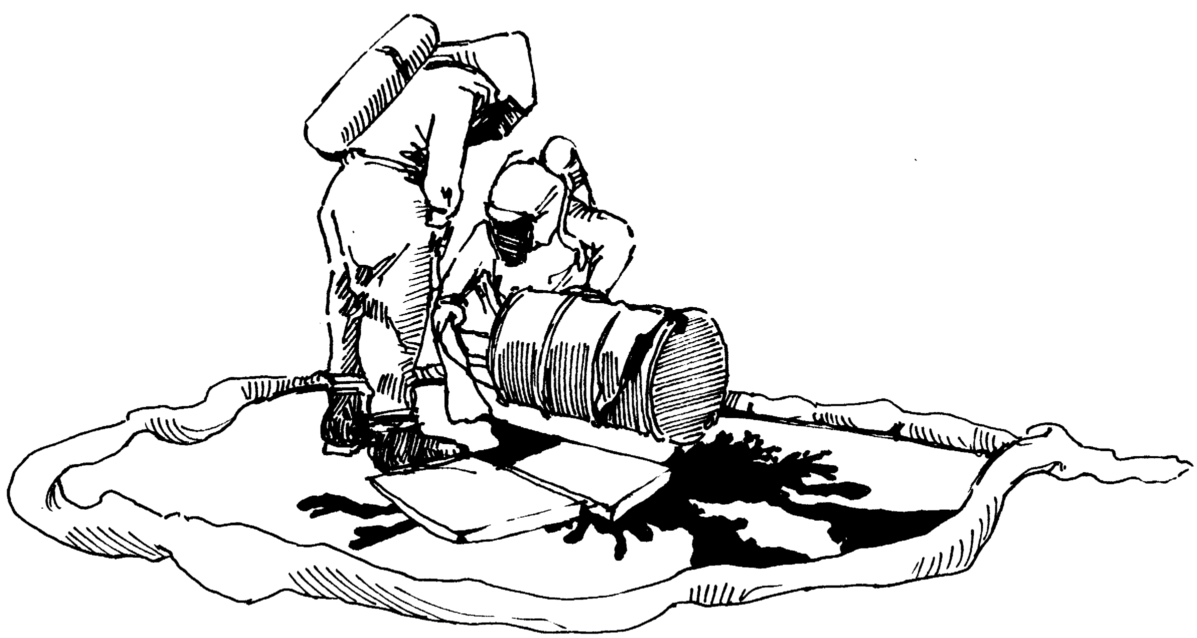
Your site must have a spill control plan that describes actions to take if either a minor or major spill occurs. Spill control includes:

1) Containment:

- Plugging—The leaking drum is plugged to prevent or limit further release. Common plugging materials include wood, soap, rags, and commercial products. Plug materials must be compatible with the chemical which is leaking

- Patching—A patch is applied over the leaking area. Patching materials include rubber, patching mud, and tape. Patching materials must be compatible with the chemical that is leaking

- Over packing—Placing a leaking drum into a compatible larger drum will contain the spread of the contents



2) Confinement keeps the spill in a defined area:

- **Diking**—Dikes may be built around the perimeter of the leak with sand, earth, straw, sorbent, or similar materials. The diking material must be compatible with the spill material. Plastic sheeting can be used as an additional barrier

- **Blocking**—Drains, ditches, or storm sewers should be covered and blocked to prevent run-off of spill materials. This blocking can be done with a sorbent pad, a piece of plastic, or a rubber pad. If flammable or toxic materials enter these systems, the potential for damage to property or people is increased

- **Absorption**—Run-off can sometimes be absorbed with dirt, sand, soda ash, saw dust, wood chips, peat moss, vermiculite, foam, or other material. The spill should run into the sorbent. The sorbent must be compatible with the spill. For example, wood chips and an acid can start a fire!

- **Collection**—Run-off can also be collected in containers such as drums or buckets

Specific methods of control, containment, and confinement at sites should be outlined in an SOP.

Other Work Practice Considerations

Adequate lighting and sanitation facilities must be available if the work activities are to be performed in a safe and healthful manner. OSHA sets out minimum illumination requirements in the HAZWOPER standard, 1926.65 (m). The site safety officer determines the level of illumination.

Sanitation at Temporary Workplaces -1926.65 (n)

Water
An adequate supply of drinking (potable) water must be provided at the site, kept clean and free of contamination.

If water unfit for drinking (non-potable) is available at the site for firefighting or other purposes, the water lines and hose connections must be clearly marked to indicate that it not safe for drinking, washing, or cooking.

Toilet Facilities

Hazardous waste sites that do not have sewers must be provided with chemical, recirculating, combustion, or flush toilets, unless these are prohibited by local codes. HAZWOPER 1926.65 (n) lists the required number of toilet facilities per number of employees.

Washing Facilities and Showers
Employers must provide enough nearby washing facilities to assure that employees can remove hazardous materials from themselves.

Showers and change rooms for all employees exposed to hazardous substances and health hazards must be provided:

- Showers must be provided in accordance with 29 CFR 1926.51 (f)(4)
- Change rooms must have two separate areas, one for removal and storage of clean clothes and one for the removal and storage of work clothing. Change rooms must meet the requirements of 29 CFR 1926.51 (i)
- Showers and change rooms must be located in areas where exposures are below the PEL. If this is not possible, then a ventilation and supplied-air system must be provided to reduce exposures to the required level
- Employers must ensure that all employees shower at the end of the work shift and when leaving the site
- Showers are not required for jobs lasting less than 6 months. If the job last longer than 6 months, showers must be provided in accordance with 29CFR1926.65(n)(7)

SECTION III—
PHYSICAL AND SAFETY HAZARDS

Drowning and Toxics--Ponds and Lagoons

Ponds and lagoons store large volumes of waste materials; ponds may also be used for treating waste materials. The hazards around ponds and lagoons include:

- drowning
- corrosive and toxic materials
- gases or vapors
- unstable walking surfaces

The precautions that should be used around ponds and lagoons include:

- Safety equipment such as life jackets, safety belts, or life lines when working close to unguarded areas
- Chemical protective equipment to prevent skin contact and inhalation of chemicals
- Limit access and keep barricades secure
- Train workers

Examples of confined spaces at hazardous waste and treatment facility sites include:

- leachate collection tanks and cells
- process and storage tanks
- silos
- tank trucks
- rail cars
- trenches
- excavations and lagoons or ponds

Electrical Shocks

Electrocution is one of the most common causes of death among construction workers.

Electrical shock and electrocution are often the result of :

- contact with energized equipment and live lines, especially overhead lines
- use of electrical equipment in wet areas
- failure of equipment

Electrical hazards can be controlled by:

- lock-out/tag-out
- ground fault circuit interrupter (GFCI) equipment
- double-insulated tools and grounded tools kept in good repair

Killer Heat--Heat Stress and Heat Stroke

High temperatures put extra physical stress on the body. Long exposure to heat can cause illness, particularly if you are not accustomed to it. Wearing chemical protective clothing and equipment greatly increases the risk of heat stress even if outside temperatures are moderate.

Heat stress is a serious problem on hazardous waste sites and requires careful monitoring and awareness training for all at risk workers. These factors can increase your risk of heat stress:

- lack of physical fitness
- age
- lack of fluid intake
- alcohol and drug use
- sunburn, diarrhea, infection

To help prevent heat stress:

- drink more fluids than your thirst tells you to (especially water)
- avoid alcohol
- take regular cool-off breaks, in an air conditioned space if possible, but at least out of direct sunlight

Signs and Symptoms of Heat Stress	
Heat Cramps	
Symptoms:	painful muscle spasms
Cause:	profuse sweating and drinking large amounts of water
Treatment:	provide water and electrolytes (sodium, potassium) like diluted Gatorade™.
Heat Exhaustion	
Symptoms:	Weakness, fatigue, dizziness, pale, cool, moist skin, heavy sweating, headache, nausea
Cause:	Dehydration from profuse sweating and insufficient intake of water and salts
Treatment:	Replace water and electrolytes lost in sweat, provide rest in a cool place. Do not send worker back into a hot environment that day.
Heat Stroke	
Symptoms:	Very dry, hot skin with red mottled or bluish appearance; confusion; convulsions; unconsciousness; rapidly rising temperature
Cause:	Body becomes overheated because the worker does not sweat; can be fatal
Treatment:	Call for medical help immediately. Move person to cool place. Remove protective equipment. Use wet towels to reduce the vicitm's temperature. Fan rapidly to cool while waiting for help Heat stroke is a life-threatening emergency. Medical attention is required.

Frostbite and Cold--Stress

Prolonged exposure to cold environments can cause a “freezing” of the hands, toes, nose, cheeks and ears. Parts appear red and tingling, then turn pale and numb. Frostbitten tissue should be gently warmed. The victim should be given hot liquids to drink and not allowed to smoke.

Cold, wet conditions can increase your risk of muscle strain and other musculoskeletal injuries. Using vibrating tools in cold weather can lead to hand-arm vibration syndrome which causes the blood vessels in your finger tips to collapse. This causes your finger tips to go white and numb.

SUMMARY:
WORK PRACTICES

The normal way you do your work could be deadly at a hazardous waste site. For example, an ordinary hammer could start an explosion in a flammable area--a special non-sparking hammer might be needed. Special work methods are needed to protect worker safety and health.

Carefully planned, detailed written work instructions called Standard Operating Procedures (SOPs) tell you how to do the work safely. SOPs lay out work practices that are needed to protect worker safety and health. They are needed for:

- confined-space entry
- lock-out
- fire prevention
- maintenance activities
- hot work
- power tool use

SOPs should also be in place for:

- loading and unloading operations
- drum handling
- spill control
- equipment and vehicle operations
- the use of ladders and scaffolding

Sampling or moving drums is one of the most dangerous jobs you can do. Extra precautions must be taken before moving or sampling any drums that are damaged, leaking, unstable, or have any crystals around the edge. Keep absorbents and overpack drums handy any time you move a drum in case there is a spill.

At each hazardous waste site, workers must be trained in the SOPs that relate to their work.

Ponds and lagoons used for storage and treatment, as well as <u>confined spaces</u>, pose hazards. You should wear the proper protective equipment and have proper training in safe work practices when performing activities in these places.

<u>Excavation</u> sites may pose dangers such as cave-in. A competent person needs to determine whether shoring is necessary, vibration or moisture sources exist, protective equipment is available, and the location of overhead and underground utilities before beginning any work.

Electrocution by energized equipment and equipment failure may occur at hazardous waste sites. To prevent electrocution, follow precautions such as

- use only equipment in good condition
- lock out electrical and other power and
- do not do electrical repair or maintenance work unless you are trained and qualified.
- use GFCI

Heat stroke--hot, dry skin--is a medical emergency. Get the worker out of the work area and out of protective gear, call for medical help, and cool the body down with wet towels.

BACKGROUND READING MATERIAL: WORK PRACTICES

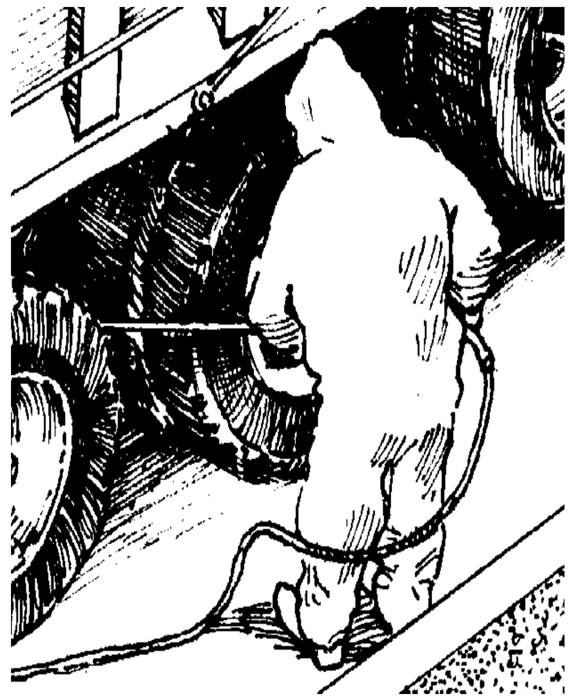
Hazardous Waste Operations and Emergency Response Standard, Federal Register, Final Rule - March 6, 1989, 29CFR1926.65 Drums and Containers.

Occupational Safety and Health Guidance Manual for Hazardous Waste Sites, (NIOSH # 85-115) 1984, Chapter 11, Handling Drums and Other Containers, p. 1-12.

EPA's Standard Operating Safety Guides, July 1988, Part 2, Standard Operating Safety Procedures.

CHAPTER 7: DECONTAMINATION

Decontamination is the process of removing contaminants from personnel and equipment to protect yourself, your fellow workers, and your family and community. It may include neutralizing contaminants by chemical means. Proper disposal is an important part of decontamination.



Chapter Objectives

After this training, you will be able to:

☞ Properly decontaminate your protective gear, yourself, your tools and equipment to protect yourself, your family, and your community.

CASE STUDY

Two workers finished a day of pumping out a tank full of xylene. They rinsed off their reusable suits with water and hung them up to dry. When they came back the next day the suit material felt strange--it had become soft and sticky. The suits had to be thrown away. What happened?

*The workers were wearing the right suits, but they did not clean them off with soap--they did not **decontaminate** properly. Poor decontamination can damage suits or equipment and poison you or your family. In this chapter you will learn about how to decontaminate properly to prevent this kind of problem.*

WHAT IS DECONTAMINATION?

Every time you leave the hot zone you need to decontaminate (decon). You will leave the hot zone through a series of wash stations in the warm zone that are called the **decontamination line** or **decon line**. Workers in suits and respirators may be assigned to the decon line to scrub and rinse protective gear and help you take it off.

The only way out of the hot zone should be through the decon line. You must go through decon every time you leave the hot zone.

On most decon lines you will stand in a tub and your suit will be scrubbed with scrub brushes and compatible cleaner. Then you will step into another tub for a rinse. You will take off your outer boots, outer gloves, and then your suit, carefully rolling them inside out so you do not get chemicals from the outside of the suit on your skin. You take off your respirator last. Some decon lines are very long and complicated, some are short. But the basic idea is always the same.

The decon line has to be set up and operational **before anyone starts work in the hot zone.**

Decontamination Procedures

Decontamination procedures are described in the employer's safety and health plan.

Proper decontamination procedures must:

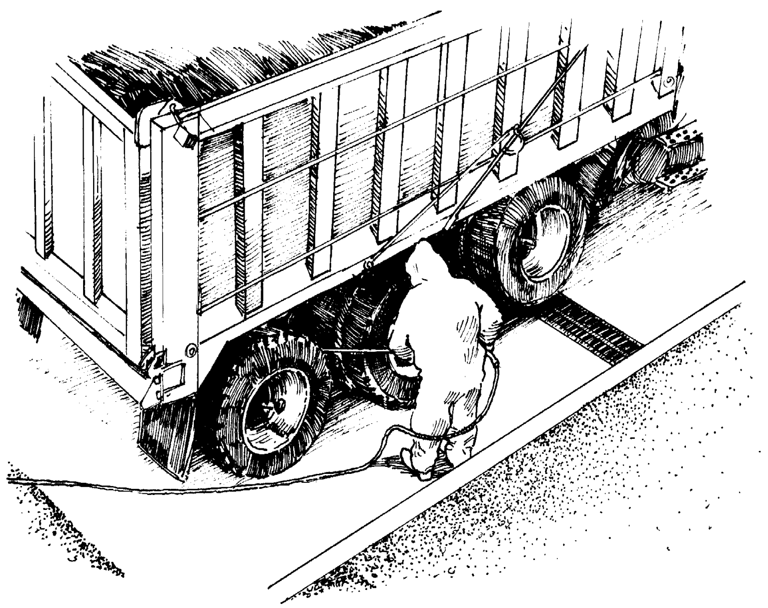
- be communicated to employees and implemented before employees or equipment enter the work site
- control hazards, including runoff
- protect workers from exposure to hazardous substances or contaminated equipment
- prevent continued contamination and permeation of the hazardous substance into PPE, other equipment, and tools
- prevent the mixing of incompatible substances
- prevent the uncontrolled transfer of contaminants to the home and community and to employees in clean areas
- be monitored by the safety and health supervisor and revised as necessary

When Is Decontamination Required?

Each waste site presents different risks of contamination. The site-specific safety and health plan should state when, where, and how decontamination will occur. Decontamination is needed:

- when PPE or clothing becomes contaminated
- before personnel go from a hot zone to a cold zone
- before workers eat, drink, smoke, or use rest room facilities
- before equipment and transport trucks leave the site

The site decontamination plan must appear in the required safety and health plan. The plan must be operational before any personnel or equipment enters areas with hazardous substances. The plan must be monitored by the site safety and health supervisor.



Worker using high-pressure water to decontaminate tires of a truck leaving a Superfund site.

The Decontamination Plan Must Contain The Following Information:
■ A description of the <u>location</u> and <u>layout</u> of decontamination stations ■ A list of the decontamination <u>equipment</u> needed (for example, water, scrubbing brushes) ■ PPE to be worn by decontamination workers ■ Specific <u>procedures</u> for decontamination of substances that may be encountered on the site ■ Methods for <u>preventing</u> contamination of clean areas ■ Procedures for <u>minimizing worker contact</u> with contaminants during removal of PPE ■ Safe <u>disposal methods</u> for clothing and equipment which are not completely decontaminated ■ <u>Revisions</u> whenever the type of PPE changes, the site conditions change, or the site hazards are reassessed based on new information

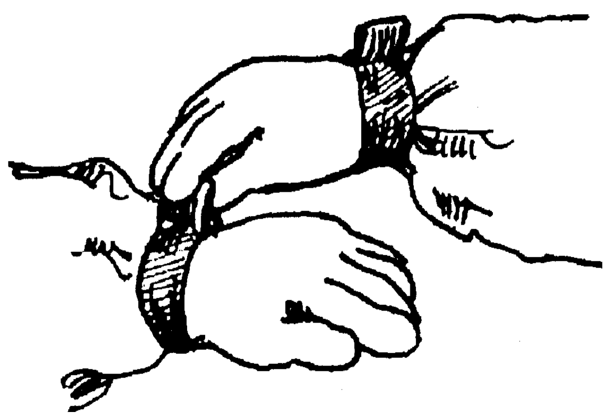
Protective clothing and equipment must be decontaminated, cleaned, maintained, or replaced as often as necessary to protect the worker effectively. Whenever a hazardous substance gets on permeable non-chemically resistant clothing you must remove and discard the clothing and remove the contamination.

Preventing Contamination

It is important to minimize contact with hazardous substances. SOPs should establish practices which minimize exposure and maximize worker protection.

For example, these PPE practices can minimize worker exposure:

- before each use inspect PPE to ensure it is in good condition
- close zippers, buttons, and snaps fully
- tuck inner gloves under the sleeves and outer gloves over sleeves
- wear a third pair of tough outer gloves over the sleeves
- tuck boots under the legs of outer clothing
- wear hoods over the respirator harness
- tape and tab all joints (if tape adhesive is compatible with suit materials) to help prevent contaminants from getting inside gloves, boots, and jackets



Close-up of Taping Joints

Reducing Contamination

Safe work practices can help reduce the amount of contamination during routine work activities, for example:

- follow SOPs that minimize contact with hazardous substances
- do not kneel or walk through puddles or areas of obvious contamination
- properly dispose of decontamination equipment and solvents
- use drum grapplers, impact wrenches, and remote techniques for sampling, handling, and drum-opening
- cover monitoring and sampling instruments with plastic bags
- wear disposable outer garments and use disposable equipment whenever possible

Decontamination Procedures

All personnel, clothing, equipment, and sample containers leaving contaminated areas must be decontaminated.

Decontamination may**:**

- physically remove contaminants
- chemically remove contaminants
- rinse off contaminants
- disinfect and sterilize (infectious materials)
- combine the above methods

Physical Removal of Contaminants

Some contaminants stick to the surface of PPE and other equipment. They can be removed by scraping, brushing, washing, and wiping.

Dust and vapors that cling to PPE and machinery may become trapped in small openings, such as the weave of the fabric, and can be removed with water or a liquid rinse.

Volatile liquid contaminants can be removed from protective clothing or equipment by evaporation followed by a water rinse. Be careful not to inhale vaporizing chemicals.

Chemical Removal of Contaminants

Chemical neutralization decontamination requires planning and training. The chemicals in the solution must be compatible with the clothing and equipment being cleaned.

Rinsing off Contaminants

Soap and water solutions are commonly used to help remove contaminants.

Multiple rinses with clean solutions will remove more contaminants than a single rinse with the same volume of solution.

Disinfecting and Sterilizing

Chemical disinfectants can kill some infectious agents. Disposable PPE is recommended for use with infectious agents.

All equipment that cannot be decontaminated, such as wooden handles, and any solvents used must be properly disposed of or packaged for transport to the next work site.

Personnel Decontamination Line

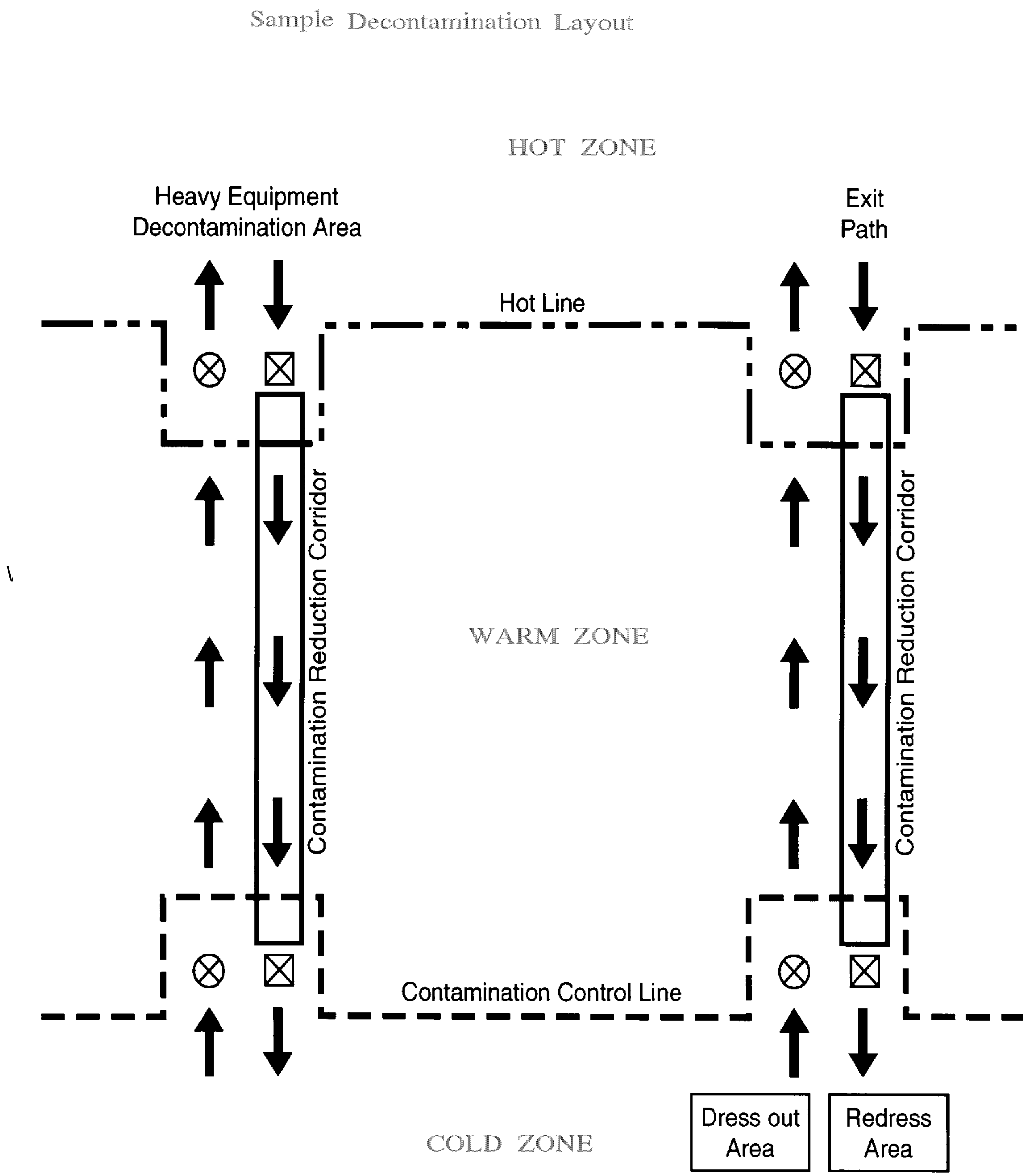
Decontamination must occur before personnel enter any clean areas. Procedures will vary depending on the nature and extent of contamination.

The decontamination line is made up of a series of stations that reduce contamination. The stations are arranged in order of decreasing contamination, preferably in a straight line. All decontamination activities are located in the Contamination Reduction Corridor (CRC). .

Outer, more heavily contaminated items such as boots, gloves, and suits should be decontaminated and removed first. Less-contaminated items, for example inner boots and gloves are removed next.

See the sample decontamination line shown on Page 9.

SAMPLE DECON LAYOUT



Source: Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities, DHHS 85-115 NIOSH, OSHA, U.S. Coast Guard, EPA.

Decontamination Steps by Work Zone

Decontamination begins as you exit the Hot Zone. It ends before you enter the Cold Zone.

Hot Zone:
Hazards are in the Hot Zone. The "Hot line" is the outer boundary and should be clearly marked with hazard tape, signs, or ropes.

Warm Zone:
Decontamination activities occur in this zone. Protective equipment and clothing are removed to prevent the transfer of hazardous substances to cleaner areas.

Cold Zone:
The Cold Zone is free of contamination. Workers who have been in the Hot Zone are medically checked out in the Cold Zone. This zone contains the administrative and other support functions that keep the zones running smoothly.

Protecting Decontamination Line Workers

Workers at the start of the decon line (toward the Hot Zone) will need more protection from contaminants than workers at the end of the decon line. Decon workers wear the same level of protection or no more than one level of protection below Hot Zone workers. Decon workers must never wear less than a level C protection. The safety and health plan should specify the level of PPE to be worn at all positions by decon line workers.

Decontamination of Equipment and Breathing Apparatus

Decontamination of equipment prevents deterioration of the equipment and controls the spread of hazardous substances.

- Monitors: contaminated monitoring equipment requires special cleaning. EPA regional laboratories or the manufacturer can provide information on proper decontamination methods

- Tools: Metal tools should be cleaned, as appropriate, by chemical or physical means. Wooden tools and tools with wooden handles are difficult to decontaminate because they absorb chemicals

- Respirators: The safety and health plan must detail the methods for decontaminating all respirators. Certain parts of contaminated SCBAs and other respirators, such as the harness assembly and leather or cloth components, are difficult to decontaminate. If grossly contaminated, they may need to be discarded. Rubber components can be soaked in soap and water and scrubbed with a brush, depending on the contaminant. Regulators must be maintained according to the manufacturer's recommendations

Preventing Spread of Contamination

Contaminated wash and rinse solutions must be contained and properly disposed of. Tools used in the Hot Zone must not be removed from the Hot Zone unless they are decontaminated. Contaminated clothing, tools, buckets, brushes, etc. must be secured in drums or other containers and properly labeled. The spent solutions and runoff must be transferred to properly labeled drums and disposed of according to local, state, and federal regulations.

Safety Precautions for Decontamination

- Make sure that decontamination solutions are compatible with the hazardous substances being removed to prevent a reaction which could produce an explosion, heat, or toxic products
- Make sure there are enough decon workers to help each person through the line
- Provide hand-holds while boots are being washed or boot covers removed
- Apply "gripper decals"to slippery surfaces to reduce the likelihood of slips
- Provide benches (not wooden unless they will be disposed of after the job) for personnel to sit on at stations where boots or suits are removed
- Be sure all areas are cleaned
- Prevent unauthorized employees from removing protective clothing or equipment from change rooms

Did The Decon Work?

You can inspect decontaminated items to make sure all visible signs of contamination are gone. There is no on-the-spot test to use to assure total decontamination. PPE can be sent to a lab to be analyzed for the presence of contamination. The final rinse can also be analyzed to help determine the effectiveness of decontamination.

SUMMARY: DECONTAMINATION

Decontamination is important to prevent the spread of hazardous substances beyond the site. Proper procedures must be developed before a clean-up job begins. Remove contamination of personnel and expensive equipment such as SCBAs and monitors. During the development of the work plan, work zones should be established to control the spread of contaminants. There are three zones:

The hot zone is the work area. Only personnel in adequate PPE should be in this zone.

The warm zone is the area where decontamination occurs. Decon workers usually wear PPE equal to, or one level less than, cleanup workers.

The cold zone is the area for support personnel. There are no hazardous waste materials in the cold zone.

The decon line must be set up and ready to go before anyone enters the hot zone.

Methods for decontaminating PPE and equipment vary depending on the substance at the site. Basic methods include:

- rinsing or dissolving (with water or other chemicals),
- scraping, brushing, and wiping,
- evaporation, then rinsing,
- using soap,
- chemical disinfection,
- combinations of the above.

The decontamination line is an organized series of procedures that is performed in a specific sequence. It reduces levels of contamination on personnel, PPE, and equipment until no contaminant is present.

Each procedure is performed at a separate station. Stations are arranged in order of decreasing contamination. Anything that cannot be decontaminated or packaged for reuse must be disposed of.

Decon workers must be decontaminated before they leave the decon line. All decon equipment must be properly decontaminated or disposed of properly.

BACKGROUND READING MATERIAL: DECONTAMINATION

Hazardous Waste Operations and Emergency Response; Final Rule
OSHA, March 6, 1989 (29CFR1926.65)

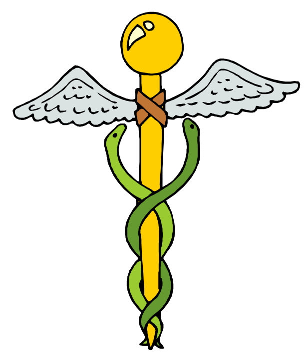
Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities
(NIOSH #85-115) October, 1985

Chapter 9	Site Control, p. 1-7
Chapter 10	Decontamination, p. 1-7

CHAPTER 8:
AIR AND MEDICAL MONITORING

The concentration of hazardous substances can be detected with monitoring instruments including oxygen meters, combustible-gas meters, and detector tubes. Medical monitoring programs keep track of possible health effects caused by exposure to hazardous substances.

Chapter Objectives
After this training, you will be able to:
☞ Determine in what situations monitoring is needed.
☞ Determine the correct instrument to be used.
☞ Interpret and use air monitoring information.
☞ Identify OSHA's requirements for medical surveillance.



CASE STUDY
Construction workers lowered a gas meter into an underground vault and the readings came back normal. A worker climbed into the vault with a gas meter, but his readings came up high. What happened?

A gas meter will not work right unless there is enough oxygen in the air. Methane from an old dump had filled up the vault and pushed oxygen out. By opening the vault, oxygen began to mix into the methane. The workers forgot to test for oxygen first. In this chapter you will learn about how to use different kinds of gas testers and what some of their limits are to prevent this kind of problem.

WHAT IS MONITORING?

At a hazardous waste site you need to be able to answer questions such as:

What is in that barrel?
How much lead is in this soil?
How much gas is in the air where Jim is working?
After a chlorine gas leak, how far did the gas cloud spread?

All of these questions can be answered by **chemical monitoring**. Monitoring is very important because it tells you:

What kind of suit and respirator you need to protect yourself.
What kinds of special equipment and tools you need to use (like fans).
What kinds of special work methods you need to use (like water sprays).
Where dangers are on the hazardous waste site.

The Importance of Air Monitoring

There are many different ways to measure chemicals. Each way of measuring answers a different question. Each way of measuring has serious limits and many are not accurate.

Monitoring provides important information about the presence of hazardous substances. No single instrument can detect all hazards, but proper use of air-sampling equipment can provide information to help protect workers' health. Using the wrong type of instrument may expose workers to an unsafe work environment.

Monitoring must be performed whenever employees may be exposed to hazardous substances, monitoring results are one criteria in selecting PPE.

Airborne exposures are very complex and can change a lot. A monitoring plan must be set up by a knowledgeable person in charge of site safety. The frequency of monitoring will be determined in the plan.

Monitoring can:

- detect potential hazardous conditions
- measure concentrations of hazardous substances

Airborne concentrations of hazardous substances should be measured to:

- determine worker exposure level, and the location and extent of hazardous worker exposures
- assist in selection of PPE and planning work activities
- determine community exposure
- create records of exposure
- determine whether employees need medical attention

Monitoring during initial entry:
■ Identifies oxygen-deficient atmospheres
■ Notes presence of flammable gases
■ Identifies chemicals present
■ Measures concentrations of contaminants to identify IDLH situations, and potential over exposures to hazardous chemicals

Periodic monitoring must be conducted when there are IDLH conditions, flammable atmospheres, or signs that exposures may have risen over acceptable limits since the last monitoring. The employer must monitor those employees likely to have the highest exposure. When workers are found to be overexposed, the monitoring program should be expanded to identify all overexposed workers. Monitoring must be repeated if there is a change in work activities or the materials that are handled.

Exposures can change when:

- work begins in a different area of the site
- new contaminants are found
- work tasks change
- obvious liquid contamination is in the work area
- weather conditions change

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What Can Be Monitored in The Air?

Oxygen-Deficient Atmospheres

Normal breathing air contains 20.9% oxygen. Air which contains less than 19.5% oxygen is **oxygen-deficient.** The oxygen in confined spaces such as tanks, pits, silos, pipelines, vaults and sewers is often oxygen-deficient. OSHA requires SAR (with escape) or SCBA respiratory protection in atmospheres with less than 19.5% oxygen.

Oxygen-Enriched Atmospheres

The atmosphere is oxygen-enriched if it contains more than 23.5% oxygen. If flammable substances are present, oxygen enrichment increases the risk of fire or explosion by providing extra oxygen.

Fire and Explosion Hazards

Flammable and explosive chemicals are detected by combustible gas meters. Oxygen content must be measured before you test for the presence of flammable materials. If the oxygen content is too low, combustible-gas meters will not register correctly.

Toxic Chemical

Instruments that give immediate results can identify only certain chemicals. If a substance cannot be identified immediately, samples are taken and sent to a lab for analysis.

Biological Hazards

The presence of bacteria, viruses, and certain parasites will affect PPE selection, as well as decontamination and disposal procedures. Specialists must be brought in to investigate biological hazards.

Radioactivity

Detection of radiation usually requires special technicians (Radiation Safety Officers) to conduct monitoring. No single instrument can measure all forms of radiation accurately.

Types of Air Sampling

There are several types of air sampling:

- Personal sampling - the monitor is worn by the worker and samples collected from his/her breathing zone
- Area sampling - the monitor is placed in the work area
- Real-time/direct- reading sampling - area monitoring equipment that provides an immediate reading of air contamination
- Indirect monitors - collect samples to be analyzed in a lab

Personal Sampling

Personal samples are usually collected by placing a battery-operated air pump on the person's belt and clipping a collection tube or filter in their breathing zone, usually on the collar. Air from the breathing zone is pulled into the collection device. The contaminants are trapped, and the sample is sent to a laboratory for analysis. Passive dosimeters are badges clipped to the collar which collect samples without using a pump.

Strengths of personal sampling:

- It is the most accurate measurement of your exposure, because the sampling device goes where you go and collects air from your breathing zone
- Results can be converted to a TWA or STEL and compared with the published exposure limits

An Air Monitor Needs to be in your Breathing Zone

Weaknesses of personal sampling:

- Laboratory analysis of the sample may take 1–14 days
- If collected over several hours, samples provide no information about ceiling exposures
- Generally you need to know what chemical you are sampling for before you sample

If you are requested to wear a sampling device:

- Be sure the monitor is positioned properly within your breathing zone
- Notify safety or sampling personnel if any problems occur
- Use the OSHA Access to Employee Exposure and Medical Records Standard,1926.33. to request the results of tests in writing
- Compare the results with OSHA PELs and recommended exposure limits - (RELs) and TLVs
- Keep the results. If you become ill the information may be helpful to your doctor
- Ask for assistance if you do not know what the results mean

Real-Time or Direct-Read Sampling

Real-time monitoring with direct-reading instruments provides an immediate measurement of exposure. The equipment used depends upon the potential hazards present.

Advantages of real-time monitoring:

- Results are immediate
- Detects high levels of toxic and flammable materials
- Used to ensure safe entry to confined space

Disadvantages of real-time monitoring:

- Instruments may not be sensitive enough to detect low but possibly harmful levels of a contaminant
- Most monitors cannot identify a specific unknown contaminant or distinguish one from another
- Background levels and other chemicals can give false readings (cross-sensitivity)

Environmental Sampling

Environmental sampling includes water sampling, soil testing, wipe testing, compatibility testing, and drum sampling.

Water Sampling

Sampling and analysis of groundwater and water from wells, ponds, and streams helps determine whether wastes are present.

Soil Testing

Soil testing indicates how much area contamination there is, how deep it is, and the boundaries of the contaminated area.

Wipe Testing (Swipe Testing)

Wipe testing shows which surfaces are contaminated. A piece of cloth or other material is swiped across a surface and then submitted to a laboratory for analysis.

Drum Sampling

Drum sampling identifies the contents of drums and tanks. A glass rod called a "thief" or a "coliwasa" is inserted into the drum. The captured sample is then bottled and sent away for analysis.

Compatibility Testing

Tests performed by a laboratory can determine whether the hazardous materials can be mixed safely. Compatibility software programs have been developed by the U.S. EPA, Army Corp of Engineers, and other groups.

SAMPLING INSTRUMENTS

Oxygen Meter - Measures concentration of oxygen in the air.

Keep in mind:

- Temperature, pressure and carbon dioxide can all effect readings
- Calibrate meter regularly
- User must be trained.

Combustible-Gas Indicator (CGI) - measures concentrations of flammable gas/vapors. Useful for confined space entry. Also called LEL meters.

- CGI's measure the percent of the LEL that is in the air
- Above 10% of the LEL indicates there is a potentially dangerous atmosphere for fire/explosion
- You must test for oxygen content before you test for flammable vapors. CGI's need enough oxygen to work properly

MSA 261

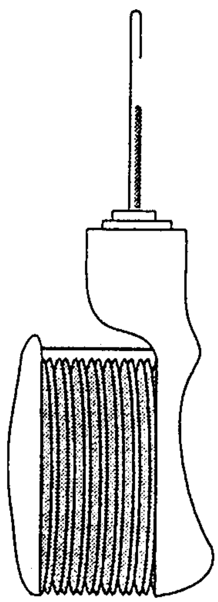
Keep in mind:

- CGI's require periodic factory calibrations
- CGI's do not respond the same to all vapors
- Models with a needle indicator require constant observation during use, as the needle may peg out (swing far to the right and back to 0 and then be misread as 0)
- User must be trained
- Must be field-calibrated (bump checked) by trained personnel before each shift
- Enough time must be allowed for contaminants to reach the instrument through the length of tubing used

Colorimetric Detector Tubes (Drager, MSA, Sensidine) - Measure gas/vapor concentrations by color change of the material in tube.

A colorimetric detector tube is a glass tube filled with a solid material or gel that contains an indicator chemical. As air is pulled through the pump, the contaminant reacts with the chemical in the tube and produces a stain proportional in length to the concentration of the contaminant.

Keep in mind:



Each tube is specific to a small range of chemicals. Even very similar chemicals will give different readings.

Accuracy is +/- (plus or minus) 25% at best.

Pump must be checked for leaks and calibrated.

Tubes have a limited lifetime, always check expiration date.

Results may be affected by temperature and humidity.

User must be trained in reading the scales on the tubes used.

User must follow specific pump-stroke requirements.

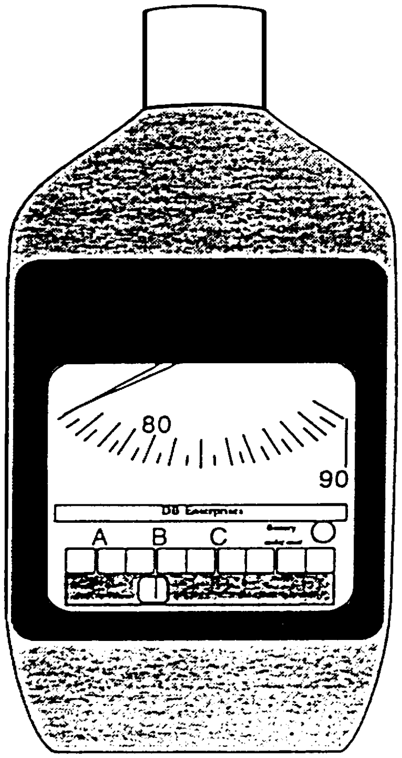
Other Monitoring Instruments

Use of photo-ionization detectors (PID), flame ionization detectors (FID), and other more complicated monitors require special training.

Radiation Sampling

No single instrument can measure all forms of radiation. On sites where radiation sources are present, a specific monitoring program should be in place which describes monitoring devices, the type of hazard, and control methods.

<u>Sound Level Meter (SLM)</u> - Direct reading monitor measures sound levels in decibels (dB). Most instruments use the A scale which mimics how the ear responds to noise.



Keep in mind:

- Requires calibration before and after each use
- Battery must be checked before each use
- Dial must be viewed constantly while using instrument
- Personnel must be trained to use instrument

NOTE: Personal noise dosimeters are also available. These instruments are worn by the employee during the entire shift and give a time-weighted average exposure.

SELECTING MONITORING EQUIPMENT

Site management is responsible for selecting appropriate monitoring equipment. Manufacturers should provide information about equipment uses and its limitations. NIOSH and the EPA can also provide information about equipment. Some general considerations when selecting monitoring equipment follow:

- All instruments must be electrically safe (called intrinsically safe) if used in flammable areas
- Most direct-reading instruments are designed to sample only one contaminant or group of contaminants
- <u>No</u> instrument can sample <u>all</u> toxic substances
- Make sure instruments are designed for use at the temperatures they will be exposed to
- Users must be trained in and allowed to practice monitoring procedures

SUMMARY: AIR MONITORING

Air testing or monitoring tells you what levels of chemicals workers are exposed to. Your employer will use monitoring results to choose the right personal protective equipment.

Oxygen-deficient and oxygen enriched atmospheres, fire and explosion hazards, toxic chemicals, biological hazards and radioactivity can all be monitored at the site.

Personal and area sampling is used to measure the amount of a toxic chemical in the air that a worker is exposed to. These samples must usually be sent away to a lab.

Real-time sampling gives you a direct reading of the air at the moment you use the equipment. Direct-reading instruments are used for flammable vapors, oxygen, and toxic materials. Real time sampling may be used for personal or area monitoring.

Full-shift air samples are averaged out over an 8-hour work day. Full-shift sampling is called a time-weighted average (TWA). This type of monitoring gives no information on high (peak) exposure unless many samples are taken during this 8-hour period.

OSHA requires employers to do everything they can to keep air contaminants below the Permissible Exposure Limits (PELs). Results of personal monitoring can be compared with PELs or other recommended limits (such as the Threshold Limit Values set by the American Council of Governmental Industrial Hygienists).

Personal sampling, when the worker wears a small pump all day and the sample is taken in the breathing zone, gives most accurate information on a worker's exposure. It takes a few days to get the results back.

The air in a confined space must be tested with direct-reading instruments in this order 1) oxygen (19.5%-23.5%), 2) flammable (less than 10% LEL), then 3) known toxic substances (below PEL) before you enter and periodically while workers are inside.

If the oxygen level is low or high, or if the meter is not properly calibrated, combustible gas levels will not be accurate. If the combustible gas indicator reads above 10% of the LEL, leave the area immediately and alert your supervisor.

MEDICAL SURVEILLANCE PROGRAM

Medical surveillance (29 CFR 1926.33) is a required part of the safety and health program. Workers' health must be monitored before, during employment, and at the end of employment (if the last exam was more than 6 months before the job ends). The medical surveillance program must be provided by the employer for the following employees**:**

- All employees who are or may be exposed to hazardous substances or health hazards at or above the PEL or another published exposure level (if no PEL) for 30 days or more a year
- All employees who wear a respirator for 30 days or more a year
- All employees who are injured, become ill, or show symptoms due to overexposure to hazardous substances from an emergency response or clean-up
- Members of hazardous materials response teams
  NOTE: Medical clearance must be obtained before using a respirator.

Medical examinations must be made available by the employer to each employee who falls into one or more of the above categories. Medical exams must be conducted:

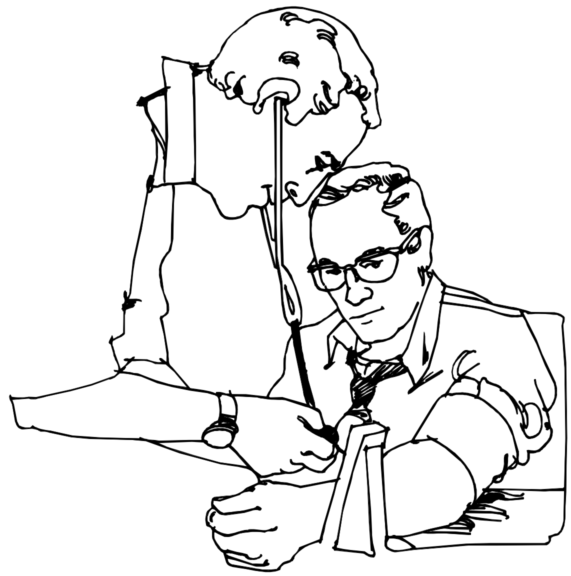
- before a new job assignment
- at least once every year unless a physician determines that a longer period, up to two years, is appropriate
- more than once each year if the doctor decides it is necessary
- when a job ends
- if an employee has symptoms which may have been caused by exposure to hazardous substances or if the employee has been injured or exposed above the PEL or published exposure levels in an emergency situation

All medical examinations and procedures must be performed by or under the supervision of a licensed physician, preferably one knowledgeable in occupational medicine. The exam is provided without cost to the employee, without loss of pay, and at a reasonable time and place.

A physician will decide on the content of the examination. You should explain to the physician the type of work you do, the potential health risks, and the type of protective equipment which you wear on the job. At a minimum medical exams must include a medical and work history. They should also include a complete physical, lung function, hearing test and an EKG for your heart.

Your employer must give the physician:

- a copy of 29 CFR 1926.33
- your job description and exposures
- your current or anticipated exposure levels
- a description of personal protective equipment used or to be used
- information from previous examinations that the physician may not have
- information required by the respirator standard 29 CFR 1926.103



Your employer has to give you a copy of the physicians written opinion, including:

- medical conditions that would make hazardous waste work or respirator use particularly risky to you
- recommended limitations on your assigned work
- results of the exam and tests, if you request them
- a statement that the doctor has told you about the exam results and any conditions which require further examination or treatment

The opinion your employer gets from the physician can discuss only findings related to your work. <u>Any other medical conditions must not be revealed to the employer</u>. You have the right to request and be given a copy of the physician's full report. Your employer must keep medical and exposure records for as long as you are employed plus another 30 years. If you work for your employer for less than a year, he does not have to keep your records provided that he gives them to you when you leave.

SUMMARY: MEDICAL SURVEILLANCE

Regular medical exams or <u>medical surveillance</u> tell you if chemicals are damaging your health. The employer may use medical surveillance results to change the way work is done.

You must have a hazardous waste <u>medical exam</u>:

- Before you begin work
- At least every two years after that
- Any time you are involved in an emergency or a serious spill
- Any time you feel sick because of work
- When you leave a job.

The medical exam must <u>include</u>:

- Your health history
- Your work history
- A doctor's physical exam (usually heart, lungs, abdomen, ears, eyes, reflexes) based on the chemicals you will work with. The physical often includes:
  - lung tests (Pulmonary Function Test or PFT)
  - heart tests (Electrocardiogram or EKG)
  - hearing test (audiogram)
  - blood tests (for lead and some other chemicals).

The doctor will write a <u>report</u> to your employer about any health problems related to your work. This report must not contain any unrelated findings. Your employer must give you a copy.

BACKGROUND READING MATERIAL: MONITORING

Hazardous Waste Operations and Emergency Response Standard
Final Rule, March 6, 1990 (29CFR1926.65) (h) Monitoring

Occupational Safety and Health Guidance Manual for Waste Site Activities
October 1985. (NIOSH # 85-115)

Chapter 7	Air Monitoring, p. 1-7

EPA's Standard Operating Safety Guides, July 1988

Part 8	Air Surveillance p. 1-8 and Annex 5 and 6
Appendix I	Characteristics of HNU Photoionizer and Organic Vapor Analyzer, p. 1-4
Appendix II	Rationale for Relating Total Atmospheric Vapor/Gas Concentrations to the Selection of the Level of Protection

NIOSH Pocket Guide to Chemical Hazards, June 1997. (NIOSH # 97-140)

Column 8	Measurement method
Table 1 (p. xix)	Codes for measurement methods

CHAPTER 9: EMERGENCY RESPONSE

Site management must provide a detailed SOP for emergency procedures in case of fire, explosion, spills, or other situations that cannot be handled by workers on site. The site safety and health plan required by OSHA 29 CFR 1926.65 requires a section on Emergency Response. Knowing what to do during an emergency helps workers protect their safety and health.

Chapter Objectives

After this training you will be able to:

☞ Discuss OSHA's requirements for a written, site-specific ERP

☞ Identify the important parts of an ERP

CASE STUDY

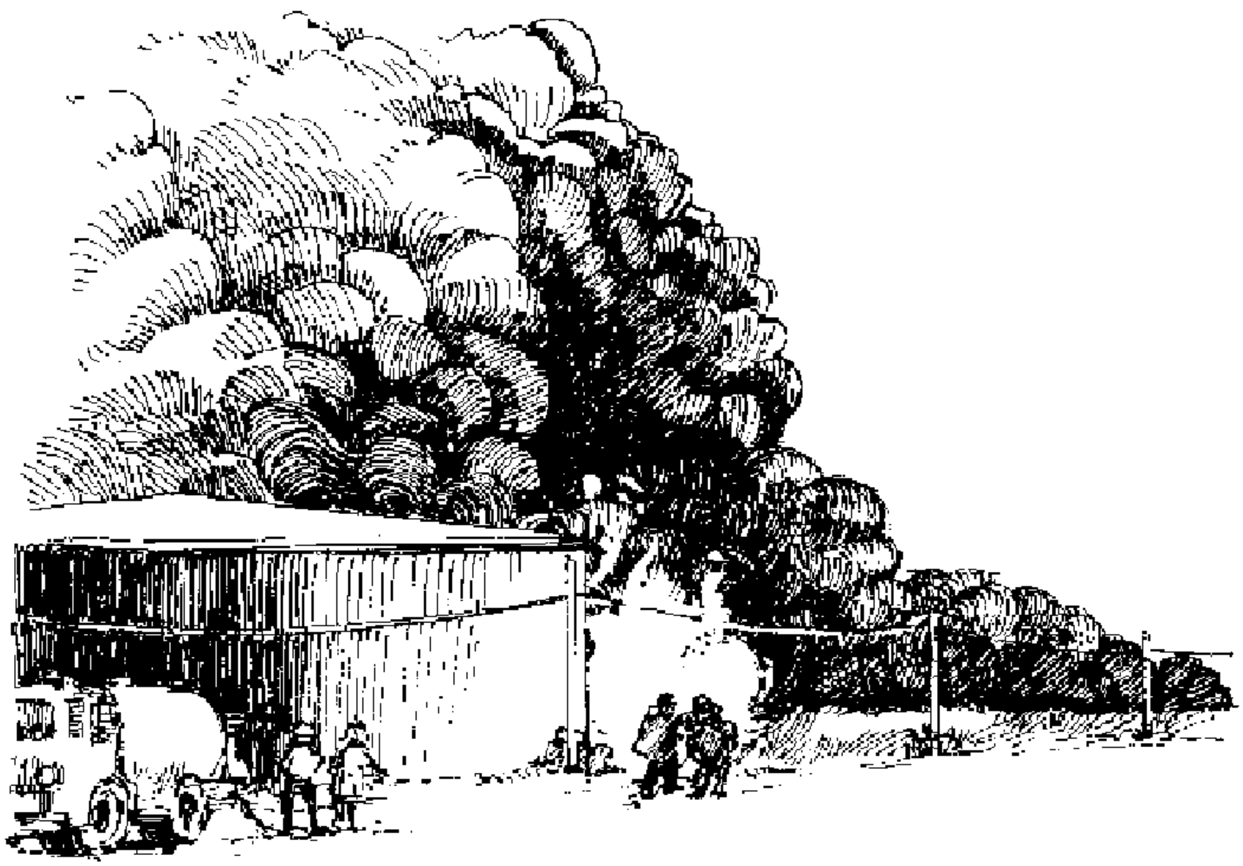
Workers were cleaning out an old factory in Brooklyn that used potassium cyanide and many different acids. During cleanup two leaking drums were put next to each other by accident. The chemicals combined to form highly toxic hydrogen cyanide gas. Workers left the building, but it was hard to see because of the gas in the air. Once they got outside there were not enough showers to hose the chemicals off everyone quickly. Finally, the first worker who finished decon called the fire department. What happened?

No one thought ahead about what kinds of emergencies could happen on this job. They did not plan ahead with exit signs, extra showers, and SOPs for notifying the fire department. In this chapter you will learn about planning for emergency response to prevent this kind of problem.

HAZWASTE EMERGENCIES

A hazardous materials emergency is a spill or release that cannot be controlled without outside help. OSHA defines “outside help” as anyone other than employees working in the immediate area or maintenance personnel. The most common emergencies at waste sites are spills, fires, and explosions.

Notify your supervisor whenever a spill or release is detected. The supervisor will decide whether outside help is required.



EMERGENCY RESPONSE PLAN (ERP)

Employers **must** develop and put in practice an emergency response plan (ERP) in accordance with OSHA 1926.65 (q) (1) to handle emergencies before work starts at the hazardous waste site. This written emergency response plan is a required part of the safety and health plan. It must be in writing and available for review and copying by employees, their representatives, personnel from OSHA, and other relevant agencies. The ERP must be consistent with the disaster, fire, local, state, and/or federal response plans.

Emergency Response Plans must contain:
■ Emergency escape procedures and escape route assignments. Including safe distances and places of refuge
■ Coordination and roles including procedures for employees who remain to perform critical operations such as machine shut-down
■ Lines of authority and communication
■ Site security and control
■ Rescue and medical duty assignment for employees
■ Decontamination, PPE and emergency equipment
■ Procedures for reporting emergencies to other responders and incidents to governmental agencies
■ Follow-up procedures

To be exempt from the requirement for a written emergency response plan employers must:

- evacuate workers when an emergency occurs
- not permit workers to help handle the emergency
- have an emergency action plan in place, consistent with OSHA 1910.38 and 1926.65

The ERP must be reviewed periodically. If site conditions have changed or new information is available concerning hazards, the employer must update the ERP.

The overall training program in site operations requires regular ERP drills.

First Aid Caution

It is not possible to include complete first aid training in the basic 40-hour Site Worker program mandated by 1926.65. However, first aid considerations and emergency medical treatment are required components of the Site Safety Plan. Personnel designated to conduct first aid activities require additional training.

In a medical emergency, get the victim out of the hot zone, decon as completely as you can, wipe off and remove PPE, and tell medical personnel what has happened.

Employee Alerting Systems

In order to alert all employees to an emergency situation, an alarm system must be in place that meets OSHA 20 CFR 1910.165. The alarm system must:

- Be heard over background noise
- notify all employees of an emergency
- result in work being stopped if necessary
- result in lowering background noise to speed communication
- signal the start of emergency procedures

The alarm system must produce a signal (noise, light, etc.) that can be perceived by all affected employees. All alarms must be distinct and recognized as signaling a specific action. The employer shall assure that all components of the alarm system are approved for the work site and operating properly.

During site-specific training, the employer must explain how to report an emergency. Emergency telephone numbers must be posted near the telephone or in obvious locations.

The system must be tested at least every two months. The system must be operational at all times, unless undergoing repairs or maintenance, but a back-up system must be operational. Maintenance work must be done by trained personnel only.

Your Responsibilities in an Emergency

If you observe a life-threatening event:

- activate the alarm system
- notify the supervisor/emergency coordinator
- carry out your designated activities

Make sure you know where to go
and what to do before an emergency occurs.

When it happens, it is too late to read the plan!

INCIDENT COMMAND SYSTEM (ICS)

The **Incident Command System (ICS**) is the chain-of-command system at an emergency. The number of people involved and the roles of each person depend on the types of emergencies that could occur at a site. Planning, training, and practice are required to make sure that each team member knows his/her role. <u>Site-specific training is required for effective response to an emergency situation</u>

The ERP must include:

- chain-of-command,
- lines of communication,
- responsibilities.

.

Priority of Protection:

- Life
- Environment
- Property

SUMMARY: EMERGENCY RESPONSE

An emergency is any sudden or unexpected event requiring outside help. Emergency response workers need more training before they may respond to an emergency incident. **This course does not qualify you as an emergency response worker**.

The emergency response plan is a written plan that is put into action before cleanup work begins. The plan must be site specific and it must be available for employees to copy or read.

You will be able to clean up small spills on site without outside help. For large spills or medical emergencies, you will need to get out and call for trained help. In a medical emergency, get the victim out of the hot zone, decon as completely as you can, wipe off and remove PPE, and tell medical personnel what has happened.

Work sites must be equipped to respond to unplanned emergencies. Telephones, horns, fire extinguishers, spill control equipment, and hand signals are effective when responding to accidents and alerting employees.

Part of planning for emergencies is deciding who is in charge. The incident command system is a pre-planned chain of command which specifies lines of authority, communication, and responsibilities.

BACKGROUND READING MATERIAL: EMERGENCY RESPONSE

Hazardous Waste Operations and Emergency Response
(29CFR1926.65) (l) Emergency Response

Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities
October 1985. (NIOSH #85-115)

EPA's Standard Operating Safety Guides. July, 1988.

Part 9	Site Safety Plan, p.2-3, 7-8
Annex 7	Emergency Operations Color Codes

NIOSH Pocket Guide to Chemical Hazards.
June 1997. DHHS (NIOSH) Publication No. 97-140.

OSHA Hazardous Waste Operations and Emergency Response Standard (HAZWOPER) 29 CFR 1926.65

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(a) "Scope, application, and definitions"

(a)(1)

"Scope." This section covers the following operations, unless the employer can demonstrate that the operation does not involve employee exposure or the reasonable possibility for employee exposure to safety or health hazards:

(a)(1)(i)

Clean-up operations required by a governmental body, whether Federal, state, local or other involving hazardous substances that are conducted at uncontrolled hazardous waste sites (including, but not limited to, the EPA's National Priority Site List (NPL), state priority site lists, sites recommended for the EPA NPL, and initial investigations of government identified sites which are conducted before the presence or absence of hazardous substances has been ascertained);

(a)(1)(ii)

Corrective actions involving clean-up operations at sites covered by the Resource Conservation and Recovery Act of 1976 (RCRA) as amended (42 U.S.C. 6901 et seq.);

(a)(1)(iii)

Voluntary clean-up operations at sites recognized by Federal, state, local or other governmental bodies as uncontrolled hazardous waste sites;

(a)(1)(iv)

Operations involving hazardous wastes that are conducted at treatment, storage, and disposal (TSD) facilities regulated by 40 CFR parts 264 and 265 pursuant to RCRA; or by agencies under agreement with U.S.E.P.A. to implement RCRA regulations; and

(a)(1)(v)

Emergency response operations for releases of, or substantial threats of releases of, hazardous substances without regard to the location of the hazard.

(a)(2)

Application.

(a)(2)(i)

All requirements of part 1910 and part 1926 of title 29 of the Code of Federal Regulations apply pursuant to their terms to hazardous waste and emergency response operations whether covered by this section or not. If there is a conflict or overlap, the provision more protective of employee safety and health shall apply without regard to 29 CFR 1926.20(e)(1).

(a)(2)(ii)

Hazardous substance clean-up operations within the scope of paragraphs (a)(1)(i) through (a)(1)(iii) of this section must comply with all paragraphs of this section except paragraphs (p) and (q).

(a)(2)(iii)

Operations within the scope of paragraph (a)(1)(iv) of this section must comply only with the requirements of paragraph (p) of this section.

Notes and Exceptions:

(a)(2)(iii)(A)

All provisions of paragraph (p) of this section cover any treatment, storage or disposal (TSD) operation regulated by 40 CFR parts 264 and 265 or by state law authorized under RCRA, and required to have a permit or interim status from EPA pursuant to 40 CFR 270.1 or from a state agency pursuant to RCRA.

(a)(2)(iii)(B)

Employers who are not required to have a permit or interim status because they are conditionally exempt small quantity generators under 40 CFR 261.5 or are generators who qualify under 40 CFR 262.34 for exemptions from regulation under 40 CFR parts 264, 265 and 270 ("excepted employers") are not covered by paragraphs (p)(1) through (p)(7) of this section. Excepted employers who are required by the EPA or state agency to have their employees engage in emergency response or who direct their employees to engage in emergency response are covered by paragraph (p)(8) of this section, and cannot be exempted by (p)(8)(i) of this section. Excepted employers who are not required to have employees engage in emergency response, who direct their employees to evacuate in the case of such emergencies and who meet the requirements of paragraph (p)(8)(i) of this section are exempt from the balance of paragraph (p)(8) of this section.

(a)(2)(iii)(C)

If an area is used primarily for treatment, storage or disposal, any emergency response operations in that area shall comply with paragraph (p)(8) of this section. In other areas not used primarily for treatment, storage, or disposal, any emergency response operations shall comply with paragraph (q) of this section. Compliance with the requirements of paragraph (q) of this section shall be deemed to be in compliance with the requirements of paragraph (p)(8) of this section.

(a)(2)(iv)

Emergency response operations for releases of, or substantial threats of releases of, hazardous substances which are not covered by paragraphs (a)(1)(i) through (a)(1)(iv) of this section must only comply with the requirements of paragraph (q) of this section.

(a)(3)

Definitions

"Buddy system" means a system of organizing employees into work groups in such a manner that each employee of the work group is designated to be observed by at least one other employee in the work group. The purpose of the buddy system is to provide rapid assistance to employees in the event of an emergency.

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

"Decontamination" means the removal of hazardous substances from employees and their equipment to the extent necessary to preclude the occurrence of foreseeable adverse health affects.

"Emergency response or responding to emergencies" means a response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual-aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance. Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area, or by maintenance personnel are not considered to be emergency responses within the scope of this standard. Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses.

"Facility" means (A) any building, structure, installation, equipment, pipe or pipeline (including any pipe into a sewer or publicly owned treatment works), well, pit, pond, lagoon, impoundment, ditch, storage container, motor vehicle, rolling stock, or aircraft, or (B) any site or area where a hazardous substance has been deposited, stored, disposed of, or placed, or otherwise come to be located; but does not include any consumer product in consumer use or any water-borne vessel.

"Hazardous materials response (HAZMAT) team" means an organized group of employees, designated by the employer, who are expected to perform work to handle and control actual or potential leaks or spills of hazardous substances requiring possible close approach to the substance. The team members perform responses to releases or potential releases of hazardous substances for the purpose of control or stabilization of the incident. A HAZMAT team is not a fire brigade nor is a typical fire brigade a HAZMAT team. A HAZMAT team, however, may be a separate component of a fire brigade or fire department.

"Hazardous substance" means any substance designated or listed under paragraphs (A) through (D) of this definition, exposure to which results or may result in adverse affects on the health or safety of employees:

(A) Any substance defined under section 101(14) of CERCLA;

(B) Any biological agent and other disease-causing agent which after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any person, either directly from the environment or indirectly by ingestion through food chains, will or may reasonably be anticipated to cause death, disease, behavioral abnormalities, cancer, genetic mutation, physiological malfunctions (including malfunctions in reproduction) or physical deformations in such persons or their offspring;

(C) Any substance listed by the U.S. Department of Transportation as hazardous materials under 49 CFR 172.101 and appendices; and

(D) Hazardous waste as herein defined.

"Hazardous waste" means -

(A) A waste or combination of wastes as defined in 40 CFR 261.3, or

(B) Those substances defined as hazardous wastes in 49 CFR 171.8.

"Hazardous waste operation" means any operation conducted within the scope of this standard.

"Hazardous waste site" or "Site" means any facility or location within the scope of this standard at which hazardous waste operations take place.

"Health hazard" means a chemical, mixture of chemicals or a pathogen for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, heptaotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. It also includes stress due to temperature extremes. Further definition of the terms used above can be found in appendix A to 29 CFR 1926.59.

"IDLH" or "Immediately dangerous to life or health" means an atmospheric concentration of any toxic, corrosive or asphyxiant substance that poses an immediate threat to life or would cause irreversible or delayed adverse health effects or would interfere with an individual's ability to escape from a dangerous atmosphere.

"Oxygen deficiency" means that concentration of oxygen by volume below which atmosphere supplying respiratory protection must be provided. It exists in atmospheres where the percentage of oxygen by volume is less than 19.5 percent oxygen.

"Permissible exposure limit" means the exposure, inhalation or dermal permissible exposure limit specified either in 1926.55, elsewhere in subpart D, or in other pertinent sections of this part.

"Published exposure level" means the exposure limits published in "NIOSH Recommendations for Occupational Health Standards" dated 1986 incorporated by reference, or if none is specified, the exposure limits published in the standards specified by the American Conference of Governmental Industrial Hygienists in their publication "Threshold Limit Values and Biological Exposure Indices for 1987-88" dated 1987 incorporated by reference.

"Post emergency response" means that portion of an emergency response performed after the immediate threat of a release has been stabilized or eliminated and clean-up of the site has begun. If post emergency response is performed by an employer's own employees who were part of the initial emergency response, it is considered to be part of the initial response and not post emergency response. However, if a group of an employer's own employees, separate from the group providing initial response, performs the clean-up operation, then the separate group of employees would be considered to be performing post-emergency response and subject to paragraph (q)(11) of this section.

"Qualified person" means a person with specific training, knowledge and experience in the area for which the person has the responsibility and the authority to control.

"Site safety and health supervisor (or official)" means the individual located on a hazardous waste site who is responsible to the employer and has the authority and knowledge necessary to implement the site safety and health plan and verify compliance with applicable safety and health requirements.

"Small quantity generator" means a generator of hazardous wastes who in any calendar month generates no more than 1,000 kilograms (2,205 pounds) of hazardous waste in that month.

"Uncontrolled hazardous waste site," means an area identified as an uncontrolled hazardous waste site by a governmental body, whether Federal, state, local or other where an accumulation of hazardous substances creates a threat to the health and safety of individuals or the environment or both. Some sites are found on public lands such as those created by former municipal, county or state landfills where illegal or poorly managed waste disposal has taken place. Other sites are found on private property, often belonging to generators or former generators of hazardous substance wastes. Examples of such sites include, but are not limited to, surface impoundments, landfills, dumps, and tank or drum farms. Normal operations at TSD sites are not covered by this definition.

(b) **"Safety and health program."**

Note to (b): Safety and health programs developed and implemented to meet other Federal, state, or local regulations are considered acceptable in meeting this requirement if they cover or are modified to cover the topics required in this paragraph. An additional or separate safety and health program is not required by this paragraph.

(b)(1) General.

(b)(1)(i)

Employers shall develop and implement a written safety and health program for their employees involved in hazardous waste operations. The program shall be designed to identify, evaluate, and control safety and health hazards, and provide for emergency response for hazardous waste operations.

(b)(1)(ii)

The written safety and health program shall incorporate the following:

(b)(1)(ii)(A)

An organizational structure;

(b)(1)(ii)(B)

A comprehensive workplan;

(b)(1)(ii)(C)

A site-specific safety and health plan which need not repeat the employer's standard operating procedures required in paragraph (b)(1)(ii)(F) of this section;

(b)(1)(ii)(D)

The safety and health training program;

(b)(1)(ii)(E)

The medical surveillance program;

(b)(1)(ii)(F)

The employer's standard operating procedures for safety and health; and

(b)(1)(ii)(G)

Any necessary interface between general program and site specific activities.

(b)(1)(iii)

Site excavation. Site excavations created during initial site preparation or during hazardous waste operations shall be shored or sloped as appropriate to prevent accidental collapse in accordance with subpart P of 29 CFR part 1926.

(b)(1)(iv)

Contractors and sub-contractors. An employer who retains contractor or sub-contractor services for work in hazardous waste operations shall inform those contractors, sub-contractors, or their representatives of the site emergency response procedures and any potential fire, explosion, health, safety or other hazards of the hazardous waste operation that have been identified by the employer, including those identified in the employer's information program.

(b)(1)(v)

Program availability. The written safety and health program shall be made available to any contractor or subcontractor or their representative who will be involved with the hazardous waste operation; to employees; to employee designated representatives; to OSHA personnel, and to personnel of other Federal, state, or local agencies with regulatory authority over the site.

(b)(2)

Organizational structure part of the site program -

(b)(2)(i)

The organizational structure part of the program shall establish the specific chain of command

and specify the overall responsibilities of supervisors and employees. It shall include, at a minimum, the following elements:

(b)(2)(i)(A)

A general supervisor who has the responsibility and authority to direct all hazardous waste operations.

(b)(2)(i)(B)

A site safety and health supervisor who has the responsibility and authority to develop and implement the site safety and health plan and verify compliance.

(b)(2)(i)(C)

All other personnel needed for hazardous waste site operations and emergency response and their general functions and responsibilities.

(b)(2)(i)(D)

The lines of authority, responsibility, and communication.

(b)(2)(ii)

The organizational structure shall be reviewed and updated as necessary to reflect the current status of waste site operations.

(b)(3)

Comprehensive workplan part of the site program. The comprehensive workplan part of the program shall address the tasks and objectives of the site operations and the logistics and resources required to reach those tasks and objectives.

(b)(3)(i)

The comprehensive workplan shall address anticipated clean-up activities as well as normal operating procedures which need not repeat the employer's procedures available elsewhere.

(b)(3)(ii)

The comprehensive workplan shall define work tasks and objectives and identify the methods for accomplishing those tasks and objectives.

(b)(3)(iii)

The comprehensive workplan shall establish personnel requirements for implementing the plan.

(b)(3)(iv)

The comprehensive workplan shall provide for the implementation of the training required in paragraph (e) of this section.

(b)(3)(v)

The comprehensive workplan shall provide for the implementation of the required informational programs required in paragraph (i) of this section.

(b)(3)(vi)

The comprehensive workplan shall provide for the implementation of the medical surveillance program described in paragraph (f) of this section.

(b)(4)

Site-specific safety and health plan part of the program -

(b)(4)(i)

General. The site safety and health plan, which must be kept on site, shall address the safety and health hazards of each phase of site operation and include the requirements and procedures for employee protection.

(b)(4)(ii)

Elements. The site safety and health plan, as a minimum, shall address the following:

(b)(4)(ii)(A)

A safety and health risk or hazard analysis for each site task and operation found in the workplan.

(b)(4)(ii)(B)

Employee training assignments to assure compliance with paragraph (e) of this section.

(b)(4)(ii)(C)

Personal protective equipment to be used by employees for each of the site tasks and operations being conducted as required by the personal protective equipment program in paragraph (g)(5) of this section.

(b)(4)(ii)(D)

Medical surveillance requirements in accordance with the program in paragraph (f) of this section.

(b)(4)(ii)(E)

Frequency and types of air monitoring, personnel monitoring, and environmental sampling techniques and instrumentation to be used, including methods of maintenance and calibration of monitoring and sampling equipment to be used.

(b)(4)(ii)(F)

Site control measures in accordance with the site control program required in paragraph (d) of this section.

(b)(4)(ii)(G)

Decontamination procedures in accordance with paragraph (k) of this section.

(b)(4)(ii)(H)

An emergency response plan meeting the requirements of paragraph (l) of this section for safe and effective responses to emergencies, including the necessary PPE and other equipment.

(b)(4)(ii)(I)

Confined space entry procedures.

(b)(4)(ii)(J)

A spill containment program meeting the requirements of paragraph (j) of this section.

(b)(4)(iii)

Pre-entry briefing. The site specific safety and health plan shall provide for pre-entry briefings to be held prior to initiating any site activity, and at such other times as necessary to ensure that employees are apprised of the site safety and health plan and that this plan is being followed. The information and data obtained from site characterization and analysis work required in paragraph (c) of this section shall be used to prepare and update the site safety and health plan.

(b)(4)(iv)

Effectiveness of site safety and health plan. Inspections shall be conducted by the site safety and health supervisor or, in the absence of that individual, another individual who is knowledgeable in occupational safety and health, acting on behalf of the employer as necessary to determine the effectiveness of the site safety and health plan. Any deficiencies in the effectiveness of the site safety and health plan shall be corrected by the employer.

(c) **Site characterization and analysis**

(c)(1)

General. Hazardous waste sites shall be evaluated in accordance with this paragraph to identify specific site hazards and to determine the appropriate safety and health control procedures needed to protect employees from the identified hazards.

(c)(2)

Preliminary evaluation. A preliminary evaluation of a site's characteristics shall be performed prior to site entry by a qualified person in order to aid in the selection of appropriate employee protection methods prior to site entry. Immediately after initial site entry, a more detailed evaluation of the site's specific characteristics shall be performed by a qualified person in order to further identify existing site hazards and to further aid in the selection of the appropriate engineering controls and personal protective equipment for the tasks to be performed.

(c)(3)

Hazard identification. All suspected conditions that may pose inhalation or skin absorption hazards that are immediately dangerous to life or health (IDLH), or other conditions that may cause death or serious harm, shall be identified during the preliminary survey and evaluated during the detailed survey. Examples of such hazards include, but are not limited to, confined space entry, potentially explosive or flammable situations, visible vapor clouds, or areas where biological indicators such as dead animals or vegetation are located.

(c)(4)

Required information. The following information to the extent available shall be obtained by the employer prior to allowing employees to enter a site:

(c)(4)(i)

Location and approximate size of the site.

(c)(4)(ii)

Description of the response activity and/or the job task to be performed.

(c)(4)(iii)

Duration of the planned employee activity.

(c)(4)(iv)

Site topography and accessibility by air and roads.

(c)(4)(v)

Safety and health hazards expected at the site.

(c)(4)(vi)

Pathways for hazardous substance dispersion.

(c)(4)(vii)

Present status and capabilities of emergency response teams that would provide assistance to hazardous waste clean-up site employees at the time of an emergency.

(c)(4)(viii)

Hazardous substances and health hazards involved or expected at the site, and their chemical and physical properties.

(c)(5)

Personal protective equipment. Personal protective equipment (PPE) shall be provided and used during initial site entry in accordance with the following requirements:

(c)(5)(i)

Based upon the results of the preliminary site evaluation, an ensemble of PPE shall be selected and used during initial site entry which will provide protection to a level of exposure below permissible exposure limits and published exposure levels for known or suspected hazardous substances and health hazards, and which will provide protection against other known and suspected hazards identified during the preliminary site evaluation. If there is no permissible exposure limit or published exposure level, the employer may use other published studies and information as a guide to appropriate personal protective equipment.

(c)(5)(ii)

If positive-pressure self-contained breathing apparatus is not used as part of the entry ensemble, and if respiratory protection is warranted by the potential hazards identified during the preliminary site evaluation, an escape self-contained breathing apparatus of at least five minute's duration shall be carried by employees during initial site entry.

(c)(5)(iii)

If the preliminary site evaluation does not produce sufficient information to identify the hazards or suspected hazards of the site, an ensemble providing protection equivalent to Level B PPE shall be provided as minimum protection, and direct reading instruments shall be used as appropriate for identifying IDLH conditions. (See appendix B for a description of Level B hazards and the recommendations for Level B protective equipment.)

(c)(5)(iv)

Once the hazards of the site have been identified, the appropriate PPE shall be selected and used in accordance with paragraph (g) of this section.

(c)(6)

Monitoring. The following monitoring shall be conducted during initial site entry when the site evaluation produces information that shows the potential for ionizing radiation or IDLH conditions, or when the site information is not sufficient reasonably to eliminate these possible conditions:

(c)(6)(i)

Monitoring with direct reading instruments for hazardous levels of ionizing radiation.

(c)(6)(ii)

Monitoring the air with appropriate direct reading test equipment (i.e., combustible gas meters, detector tubes) for IDLH and other conditions that may cause death or serious harm (combustible or explosive atmospheres, oxygen deficiency, toxic substances).

(c)(6)(iii)

Visually observing for signs of actual or potential IDLH or other dangerous conditions.

(c)(6)(iv)

An ongoing air monitoring program in accordance with paragraph (h) of this section shall be implemented after site characterization has determined the site is safe for the start-up of operations.

(c)(7)

Risk identification.

(c)(7)(i)

Once the presence and concentrations of specific hazardous substances and health hazards have been established, the risks associated with these substances shall be identified. Employees who will be working on the site shall be informed of any risks that have been identified. In situations covered by the Hazard Communication Standard, 29 CFR 1926.59, training required by that standard need not be duplicated.

Note to (c)(7) - Risks to consider include, but are not limited to:

(c)(7)(i)(a)

Exposures exceeding the permissible exposure limits and published exposure levels.

(c)(7)(i)(b)

IDLH concentrations.

(c)(7)(i)(c)

Potential skin absorption and irritation sources.

(c)(7)(i)(d)

Potential eye irritation sources.

(c)(7)(i)(e)

Explosion sensitivity and flammability ranges.

(c)(7)(i)(f)

Oxygen deficiency.

(c)(8)

Employee notification. Any information concerning the chemical, physical, and toxicologic properties of each substance known or expected to be present on site that is available to the employer and relevant to the duties an employee is expected to perform shall be made available to the affected employees prior to the commencement of their work activities. The employer may utilize information developed for the hazard communication standard for this purpose.

(d) **Site control**

(d)(1)

General. Appropriate site control procedures shall be implemented to control employee exposure to hazardous substances before clean-up work begins.

(d)(2)

Site control program. A site control program for protecting employees which is part of the employer's site safety and health program required in paragraph (b) of this section shall be developed during the planning stages of a hazardous waste clean-up operation and modified as necessary as new information becomes available.

(d)(3)

Elements of the site control program. The site control program shall, as a minimum, include: A site map; site work zones; the use of a buddy system; site communications including alerting means for emergencies; the standard operating procedures or safe work practices; and, identification of the nearest medical assistance. Where these requirements are covered elsewhere they need not be repeated.

(e) **Training**

(e)(1)

General.

(e)(1)(i)

All employees working on site (such as but not limited to equipment operators, general laborers and others) exposed to hazardous substances, health hazards, or safety hazards and their supervisors and management responsible for the site shall receive training meeting the requirements of this paragraph before they are permitted to engage in hazardous waste operations that could expose them to hazardous substances, safety, or health hazards, and they shall receive review training as specified in this paragraph.

(e)(1)(ii)

Employees shall not be permitted to participate in or supervise field activities until they have been trained to a level required by their job function and responsibility.

(e)(2)

Elements to be covered. The training shall thoroughly cover the following:

(e)(2)(i)

Names of personnel and alternates responsible for site safety and health;

(e)(2)(ii)

Safety, health and other hazards present on the site;

(e)(2)(iii)

Use of personal protective equipment;

(e)(2)(iv)

Work practices by which the employee can minimize risks from hazards;

(e)(2)(v)

Safe use of engineering controls and equipment on the site;

(e)(2)(vi)

Medical surveillance requirements, including recognition of symptoms and signs which might indicate overexposure to hazards; and

(e)(2)(vii)

The contents of paragraphs (G) through (J) of the site safety and health plan set forth in paragraph (b)(4)(ii) of this section.

(e)(3)

Initial training.

(e)(3)(i)

General site workers (such as equipment operators, general laborers and supervisory personnel) engaged in hazardous substance removal or other activities which expose or potentially expose workers to hazardous substances and health hazards shall receive a minimum of 40 hours of instruction off the site, and a minimum of three days actual field experience under the direct supervision of a trained, experienced supervisor.

(e)(3)(ii)

Workers on site only occasionally for a specific limited task (such as, but not limited to, ground water monitoring, land surveying, or geo-physical surveying) and who are unlikely to be exposed over permissible exposure limits and published exposure limits shall receive a minimum of 24 hours of instruction off the site, and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

(e)(3)(iii)

Workers regularly on site who work in areas which have been monitored and fully characterized indicating that exposures are under permissible exposure limits and published exposure limits where respirators are not necessary, and the characterization indicates that there are no health hazards or the possibility of an emergency developing, shall receive a minimum of 24 hours of instruction off the site and the minimum of one day actual field experience under the direct supervision of a trained, experienced supervisor.

(e)(3)(iv)

Workers with 24 hours of training who are covered by paragraphs (e)(3)(ii) and (e)(3)(iii) of this section, and who become general site workers or who are required to wear respirators, shall have the additional 16 hours and two days of training necessary to total the training specified in paragraph (e)(3)(i).

(e)(4)

Management and supervisor training. On-site management and supervisors directly responsible for, or who supervise employees engaged in, hazardous waste operations shall receive 40 hours initial training, and three days of supervised field experience (the training may be reduced to 24 hours and one day if the only area of their responsibility is employees covered by paragraphs (e)(3)(ii) and (e)(3)(iii)) and at least eight additional hours of specialized training at the time of job assignment on such topics as, but not limited to, the employer's safety and health program and the associated employee training program, personal protective equipment program, spill containment program, and health hazard monitoring procedure and techniques.

(e)(5)

Qualifications for trainers. Trainers shall be qualified to instruct employees about the subject matter that is being presented in training. Such trainers shall have satisfactorily completed a training program for teaching the subjects they are expected to teach, or they shall have the academic credentials and instructional experience necessary for teaching the subjects. Instructors shall demonstrate competent instructional skills and knowledge of the applicable subject matter.

(e)(6)

Training certification. Employees and supervisors that have received and successfully completed the training and field experience specified in paragraphs (e)(1) through (e)(4) of this section shall be certified by their instructor or the head instructor and trained supervisor as having successfully completed the necessary training. A written certificate shall be given to each person so certified. Any person who has not been so certified or who does not meet the requirements of paragraph (e)(9) of this section shall be prohibited from engaging in hazardous waste operations.

(e)(7)

Emergency response. Employees who are engaged in responding to hazardous emergency situations at hazardous waste clean-up sites that may expose them to hazardous substances shall be trained in how to respond to such expected emergencies.

(e)(8)

Refresher training. Employees specified in paragraph (e)(1) of this section, and managers and supervisors specified in paragraph (e)(4) of this section, shall receive eight hours of refresher training annually on the items specified in paragraph (e)(2) and/or (e)(4) of this section, any critique of incidents that have occurred in the past year that can serve as training examples of related work, and other relevant topics.

(e)(9)

Equivalent training. Employers who can show by documentation or certification that an employee's work experience and/or training has resulted in training equivalent to that training required in paragraphs (e)(1) through (e)(4) of this section shall not be required to provide the initial training requirements of those paragraphs to such employees and shall provide a copy of the certification or documentation to the employee upon request. However, certified employees or employees with equivalent training new to a site shall receive appropriate, site specific training before site entry and have appropriate supervised field experience at the new site. Equivalent training includes any academic training or the training that existing employees might have already received from actual hazardous waste site work experience.

(f) **Medical surveillance**

(f)(1)

General. Employers engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section and not covered by (a)(2)(iii) exceptions and employers of employees specified in paragraph (q)(9) shall institute a medical surveillance program in accordance with this paragraph.

(f)(2)

Employees covered. The medical surveillance program shall be instituted by the employer for the following employees:

(f)(2)(i)

All employees who are or may be exposed to hazardous substances or health hazards at or above the permissible exposure limits or, if there is no permissible exposure limit, above the published exposure levels for these substances, without regard to the use of respirators, for 30 days or more a year;

(f)(2)(ii)

All employees who wear a respirator for 30 days or more a year or as required by 1926.103;

(f)(2)(iii)

All employees who are injured, become ill or develop signs or symptoms due to possible overexposure involving hazardous substances or health hazards from an emergency response or hazardous waste operation; and

(f)(2)(iv)

Members of HAZMAT teams.

(f)(3)

Frequency of medical examinations and consultations. Medical examinations and consultations shall be made available by the employer to each employee covered under paragraph (f)(2) of this section on the following schedules:

(f)(3)(i)

For employees covered under paragraphs (f)(2)(i), (f)(2)(ii), and (f)(2)(iv):

(f)(3)(i)(A)

Prior to assignment;

(f)(3)(i)(B)

At least once every twelve months for each employee covered unless the attending physician believes a longer interval (not greater than biennially) is appropriate;

(f)(3)(i)(C)

At termination of employment or reassignment to an area where the employee would not be covered if the employee has not had an examination within the last six months;

(f)(3)(i)(D)

As soon as possible upon notification by an employee that the employee has developed signs or symptoms indicating possible overexposure to hazardous substances or health hazards, or that the employee has been injured or exposed above the permissible exposure limits or published exposure levels in an emergency situation;

(f)(3)(i)(E)

At more frequent times, if the examining physician determines that an increased frequency of examination is medically necessary.

(f)(3)(ii)

For employees covered under paragraph (f)(2)(iii) and for all employees including those of employers covered by paragraph (a)(1)(v) who may have been injured, received a health impairment, developed signs or symptoms which may have resulted from exposure to hazardous substances resulting from an emergency incident, or exposed during an emergency incident to hazardous substances at concentrations above the permissible exposure limits or the published exposure levels without the necessary personal protective equipment being used:

(f)(3)(ii)(A)

As soon as possible following the emergency incident or development of signs or symptoms;

(f)(3)(ii)(B)

At additional times, if the examining physician determines that follow-up examinations or consultations are medically necessary.

(f)(4)

Content of medical examinations and consultations.

(f)(4)(i)

Medical examinations required by paragraph (f)(3) of this section shall include a medical and work history (or updated history if one is in the employee's file) with special emphasis on symptoms related to the handling of hazardous substances and health hazards, and to fitness for duty including the ability to wear any required PPE under conditions (i.e., temperature extremes) that may be expected at the work site.

(f)(4)(ii)

The content of medical examinations or consultations made available to employees pursuant to paragraph (f) shall be determined by the attending physician. The guidelines in the Occupational Safety and Health Guidance Manual for Hazardous Waste Site Activities (See appendix D, Reference number 10) should be consulted.

(f)(5)

Examination by a physician and costs. All medical examinations and procedures shall be performed by or under the supervision of a licensed physician, preferably one knowledgeable in occupational medicine, and shall be provided without cost to the employee, without loss of pay, and at a reasonable time and place.

(f)(6)

Information provided to the physician. The employer shall provide one copy of this standard and its appendices to the attending physician, and in addition the following for each employee:

(f)(6)(i)

A description of the employee's duties as they relate to the employee's exposures.

(f)(6)(ii)

The employee's exposure levels or anticipated exposure levels.

(f)(6)(iii)

A description of any personal protective equipment used or to be used.

(f)(6)(iv)

Information from previous medical examinations of the employee which is not readily available to the examining physician.

(f)(6)(v)

Information required by 1926.103.

(f)(7)

Physician's written opinion.

(f)(7)(i)

The employer shall obtain and furnish the employee with a copy of a written opinion from the attending physician containing the following:

(f)(7)(i)(A)

The physician's opinion as to whether the employee has any detected medical conditions which would place the employee at increased risk of material impairment of the employee's health from work in hazardous waste operations or emergency response, or from respirator use.

(f)(7)(i)(B)

The physician's recommended limitations upon the employee's assigned work.

(f)(7)(i)(C)

The results of the medical examination and tests if requested by the employee.

(f)(7)(i)(D)

A statement that the employee has been informed by the physician of the results of the medical examination and any medical conditions which require further examination or treatment.

(f)(7)(ii)

The written opinion obtained by the employer shall not reveal specific findings or diagnoses unrelated to occupational exposures.

(f)(8)

Recordkeeping.

(f)(8)(i)

An accurate record of the medical surveillance required by paragraph (f) of this section shall be retained. This record shall be retained for the period specified and meet the criteria of 29 CFR 1926.33.

(f)(8)(ii)

The record required in paragraph (f)(8)(i) of this section shall include at least the following information:

(f)(8)(ii)(A)

The name and social security number of the employee;

(f)(8)(ii)(B)

Physician's written opinions, recommended limitations, and results of examinations and tests;

(f)(8)(ii)(C)

Any employee medical complaints related to exposure to hazardous substances;

(f)(8)(ii)(D)

A copy of the information provided to the examining physician by the employer, with the exception of the standard and its appendices.

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

Engineering controls, work practices, personal protective equipment, or a combination of these shall be implemented in accordance with this paragraph to protect employees from exposure to hazardous substances and safety and health hazards.

(g)(1)

Engineering controls, work practices and PPE for substances regulated either in 1926.55, elsewhere in subpart D, or in other pertinent sections of this part.

(g)(1)(i)

Engineering controls and work practices shall be instituted to reduce and maintain employee exposure to or below the permissible exposure limits for substances regulated either in 1926.55 or other pertinent sections of this part, except to the extent that such controls and practices are not feasible.

Note to (g)(1)(i): Engineering controls which may be feasible include the use of pressurized cabs or control booths on equipment, and/or the use of remotely operated material handling equipment. Work practices which may be feasible are removing all non-essential employees from potential exposure during opening of drums, wetting down dusty operations and locating employees upwind of possible hazards.

(g)(1)(ii)

Whenever engineering controls and work practices are not feasible or not required, any reasonable combination of engineering controls, work practices and PPE shall be used to reduce and maintain employee exposures to or below the permissible exposure limits or dose limits for substances regulated either in 1926.55 or other pertinent sections of this part.

(g)(1)(iii)

The employer shall not implement a schedule of employee rotation as a means of compliance with permissible exposure limits or dose limits except when there is no other feasible way of complying with the airborne or dermal dose limits for ionizing radiation.

(g)(1)(iv)

The provisions of subpart D shall be followed.

(g)(2)

Engineering controls, work practices, and PPE for substances not regulated either in 1926.55, elsewhere in subpart D, or in other pertinent sections of this part. An appropriate combination of engineering controls, work practices and personal protective equipment shall be used to reduce and maintain employee exposure to or below published exposure levels for hazardous substances and health hazards not regulated either in 1926.55, elsewhere in subpart D, or in other pertinent sections of this part. The employer may use the published literature and MSDS as a guide in making the employer's determination as to what level of protection the employer believes is appropriate for hazardous substances and health hazards for which there is no permissible exposure limit or published exposure limit.

(g)(3)

Personal protective equipment selection.

(g)(3)(i)

Personal protective equipment (PPE) shall be selected and used which will protect employees from the hazards and potential hazards they are likely to encounter as identified during the site characterization and analysis.

(g)(3)(ii)

Personal protective equipment selection shall be based on an evaluation of the performance characteristics of the PPE relative to the requirements and limitations of the site, the task-specific conditions and duration, and the hazards and potential hazards identified at the site.

(g)(3)(iii)

Positive pressure self-contained breathing apparatus, or positive pressure air-line respirators equipped with an escape air supply, shall be used when chemical exposure levels present will create a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(g)(3)(iv)

Totally-encapsulating chemical protective suits (protection equivalent to Level A protection as recommended in appendix B) shall be used in conditions where skin absorption of a hazardous substance may result in a substantial possibility of immediate death, immediate serious illness or injury, or impair the ability to escape.

(g)(3)(v)

The level of protection provided by PPE selection shall be increased when additional information on site conditions indicates that increased protection is necessary to reduce employee exposures below permissible exposure limits and published exposure levels for hazardous substances and health hazards. (See appendix B for guidance on selecting PPE ensembles.)

Note to (g)(3): The level of employee protection provided may be decreased when additional information or site conditions show that decreased protection will not result in hazardous exposures to employees.

(g)(3)(vi)

Personal protective equipment shall be selected and used to meet the requirements of subpart E of this part and additional requirements specified in this section.

(g)(4)

Totally-encapsulating chemical protective suits.

(g)(4)(i)

Totally-encapsulating suits shall protect employees from the particular hazards which are identified during site characterization and analysis.

(g)(4)(ii)

Totally-encapsulating suits shall be capable of maintaining positive air pressure. (See appendix A for a test method which may be used to evaluate this requirement.)

(g)(4)(iii)

Totally-encapsulating suits shall be capable of preventing inward test gas leakage of more than 0.5 percent. (See appendix A for a test method which may be used to evaluate this requirement.)

(g)(5)

Personal protective equipment (PPE) program. A written personal protective equipment program, which is part of the employer's safety and health program required in paragraph (b) of this section or required in paragraph (p)(1) of this section and which is also a part of the site-specific safety and health plan shall be established. The PPE program shall address the elements listed below. When elements, such as donning and doffing procedures, are provided by the manufacturer of a piece of equipment and are attached to the plan, they need not be rewritten into the plan as long as they adequately address the procedure or element.

(g)(5)(i)

PPE selection based upon site hazards,

(g)(5)(ii)

PPE use and limitations of the equipment,

(g)(5)(iii)

Work mission duration,

(g)(5)(iv)

PPE maintenance and storage,

(g)(5)(v)

PPE decontamination and disposal,

(g)(5)(vi)

PPE training and proper fitting,

(g)(5)(vii)

PPE donning and doffing procedures,

(g)(5)(viii)

PPE inspection procedures prior to, during, and after use,

(g)(5)(ix)

Evaluation of the effectiveness of the PPE program, and

(g)(5)(x)

Limitations during temperature extremes, heat stress, and other appropriate medical considerations.

(h) Monitoring

(h)(1)

General.

(h)(1)(i)

Monitoring shall be performed in accordance with this paragraph where there may be a question of employee exposure to hazardous concentrations of hazardous substances in order to assure proper selection of engineering controls, work practices and personal protective equipment so that employees are not exposed to levels which exceed permissible exposure limits, or published exposure levels if there are no permissible exposure limits, for hazardous substances.

(h)(1)(ii)

Air monitoring shall be used to identify and quantify airborne levels of hazardous substances and safety and health hazards in order to determine the appropriate level of employee protection needed on site.

(h)(2)

Initial entry. Upon initial entry, representative air monitoring shall be conducted to identify any IDLH condition, exposure over permissible exposure limits or published exposure levels, exposure over a radioactive material's dose limits or other dangerous condition such as the presence of flammable atmospheres or oxygen-deficient environments.

(h)(3)

Periodic monitoring. Periodic monitoring shall be conducted when the possibility of an IDLH condition or flammable atmosphere has developed or when there is indication that exposures may have risen over permissible exposure limits or published exposure levels since prior monitoring. Situations where it shall be considered whether the possibility that exposures have risen are as follows:

(h)(3)(i)

When work begins on a different portion of the site.

(h)(3)(ii)

When contaminants other than those previously identified are being handled.

(h)(3)(iii)

When a different type of operation is initiated (e.g., drum opening as opposed to exploratory well drilling).

(h)(3)(iv)

When employees are handling leaking drums or containers or working in areas with obvious liquid contamination (e.g., a spill or lagoon).

(h)(4)

Monitoring of high-risk employees. After the actual clean-up phase of any hazardous waste operation commences; for example, when soil, surface water or containers are moved or disturbed; the employer shall monitor those employees likely to have the highest exposures to hazardous substances and health hazards likely to be present above permissible exposure limits or published exposure levels by using personal sampling frequently enough to characterize employee exposures. If the employees likely to have the highest exposure are over permissible exposure limits or published exposure limits, then monitoring shall continue to determine all employees likely to be above those limits. The employer may utilize a representative sampling approach by documenting that the employees and chemicals chosen for monitoring are based on the criteria stated above.

Note to (h): It is not required to monitor employees engaged in site characterization operations covered by paragraph (c) of this section.

(i) Informational programs.

Employers shall develop and implement a program, which is part of the employer's safety and health program required in paragraph (b) of this section, to inform employees, contractors, and subcontractors (or their representative) actually engaged in hazardous waste operations of the nature, level and degree of exposure likely as a result of participation in such hazardous waste operations. Employees, contractors and subcontractors working outside of the operations part of a site are not covered by this standard.

(j) Handling drums and containers

(j)(1) General.

(j)(1)(i)

Hazardous substances and contaminated soils, liquids, and other residues shall be handled, transported, labeled, and disposed of in accordance with this paragraph.

(j)(1)(ii)

Drums and containers used during the clean-up shall meet the appropriate DOT, OSHA, and EPA regulations for the wastes that they contain.

(j)(1)(iii)

When practical, drums and containers shall be inspected and their integrity shall be assured prior to being moved. Drums or containers that cannot be inspected before being moved because of storage conditions (i.e., buried beneath the earth, stacked behind other drums, stacked several tiers high in a pile, etc.) shall be moved to an accessible location and inspected prior to further handling.

(j)(1)(iv)

Unlabelled drums and containers shall be considered to contain hazardous substances and handled accordingly until the contents are positively identified and labeled.

(j)(1)(v)

Site operations shall be organized to minimize the amount of drum or container movement.

(j)(1)(vi)

Prior to movement of drums or containers, all employees exposed to the transfer operation shall be warned of the potential hazards associated with the contents of the drums or containers.

(j)(1)(vii)

U.S. Department of Transportation specified salvage drums or containers and suitable quantities of proper absorbent shall be kept available and used in areas where spills, leaks, or ruptures may occur.

(j)(1)(viii)

Where major spills may occur, a spill containment program, which is part of the employer's safety and health program required in paragraph (b) of this section, shall be implemented to contain and isolate the entire volume of the hazardous substance being transferred.

(j)(1)(ix)

Drums and containers that cannot be moved without rupture, leakage, or spillage shall be emptied into a sound container using a device classified for the material being transferred.

(j)(1)(x)

A ground-penetrating system or other type of detection system or device shall be used to estimate the location and depth of buried drums or containers.

(j)(1)(xi)

Soil or covering material shall be removed with caution to prevent drum or container rupture.

(j)(1)(xii)

Fire extinguishing equipment meeting the requirements of subpart F of this part shall be on hand and ready for use to control incipient fires.

(j)(2)

Opening drums and containers. The following procedures shall be followed in areas where drums or containers are being opened:

(j)(2)(i)

Where an airline respirator system is used, connections to the source of air supply shall be protected from contamination and the entire system shall be protected from physical damage.

(j)(2)(ii)

Employees not actually involved in opening drums or containers shall be kept a safe distance from the drums or containers being opened.

(j)(2)(iii)

If employees must work near or adjacent to drums or containers being opened, a suitable shield that does not interfere with the work operation shall be placed between the employee and the drums or containers being opened to protect the employee in case of accidental explosion.

(j)(2)(iv)

Controls for drum or container opening equipment, monitoring equipment, and fire suppression equipment shall be located behind the explosion-resistant barrier.

(j)(2)(v)

When there is a reasonable possibility of flammable atmospheres being present, material handling equipment and hand tools shall be of the type to prevent sources of ignition.

(j)(2)(vi)

Drums and containers shall be opened in such a manner that excess interior pressure will be safely relieved. If pressure can not be relieved from a remote location, appropriate shielding shall be placed between the employee and the drums or containers to reduce the risk of employee injury.

(j)(2)(vii)

Employees shall not stand upon or work from drums or containers.

(j)(3)

Material handling equipment. Material handling equipment used to transfer drums and containers shall be selected, positioned and operated to minimize sources of ignition related to the equipment from igniting vapors released from ruptured drums or containers.

(j)(4)

Radioactive wastes. Drums and containers containing radioactive wastes shall not be handled until such time as their hazard to employees is properly assessed.

(j)(5)

Shock sensitive wastes. As a minimum, the following special precautions shall be taken when drums and containers containing or suspected of containing shock-sensitive wastes are handled:

(j)(5)(i)

All non-essential employees shall be evacuated from the area of transfer.

(j)(5)(ii)

Material handling equipment shall be provided with explosive containment devices or protective shields to protect equipment operators from exploding containers.

(j)(5)(iii)

An employee alarm system capable of being perceived above surrounding light and noise conditions shall be used to signal the commencement and completion of explosive waste handling activities.

(j)(5)(iv)

Continuous communications (i.e., portable radios, hand signals, telephones, as appropriate) shall be maintained between the employee-in-charge of the immediate handling area and both the site safety and health supervisor and the command post until such time as the handling operation is completed. Communication equipment or methods that could cause shock sensitive materials to explode shall not be used.

(j)(5)(v)

Drums and containers under pressure, as evidenced by bulging or swelling, shall not be moved until such time as the cause for excess pressure is determined and appropriate containment procedures have been implemented to protect employees from explosive relief of the drum.

(j)(5)(vi)

Drums and containers containing packaged laboratory wastes shall be considered to contain shock-sensitive or explosive materials until they have been characterized.

Caution: Shipping of shock sensitive wastes may be prohibited under U.S. Department of Transportation regulations. Employers and their shippers should refer to 49 CFR 173.21 and 173.50.

(j)(6)

Laboratory waste packs. In addition to the requirements of paragraph (j)(5) of this section, the following precautions shall be taken, as a minimum, in handling laboratory waste packs (lab packs):

(j)(6)(i)

Lab packs shall be opened only when necessary and then only by an individual knowledgeable in the inspection, classification, and segregation of the containers within the pack according to the hazards of the wastes.

(j)(6)(ii)

If crystalline material is noted on any container, the contents shall be handled as a shock-sensitive waste until the contents are identified.

(j)(7)

Sampling of drum and container contents. Sampling of containers and drums shall be done in accordance with a sampling procedure which is part of the site safety and health plan developed for and available to employees and others at the specific worksite.

(j)(8)

Shipping and transport.

(j)(8)(i)

Drums and containers shall be identified and classified prior to packaging for shipment.

(j)(8)(ii)

Drum or container staging areas shall be kept to the minimum number necessary to identify and classify materials safely and prepare them for transport.

(j)(8)(iii)

Staging areas shall be provided with adequate access and egress routes.

(j)(8)(iv)

Bulking of hazardous wastes shall be permitted only after a thorough characterization of the materials has been completed.

(j)(9)

Tank and vault procedures.

(j)(9)(i)

Tanks and vaults containing hazardous substances shall be handled in a manner similar to that for drums and containers, taking into consideration the size of the tank or vault.

(j)(9)(ii)

Appropriate tank or vault entry procedures as described in the employer's safety and health plan shall be followed whenever employees must enter a tank or vault.

(k) Decontamination

(k)(1)

General. Procedures for all phases of decontamination shall be developed and implemented in accordance with this paragraph.

(k)(2)

Decontamination procedures.

(k)(2)(i)

A decontamination procedure shall be developed, communicated to employees and implemented before any employees or equipment may enter areas on site where potential for exposure to hazardous substances exists.

(k)(2)(ii)

Standard operating procedures shall be developed to minimize employee contact with hazardous substances or with equipment that has contacted hazardous substances.

(k)(2)(iii)

All employees leaving a contaminated area shall be appropriately decontaminated; all contaminated clothing and equipment leaving a contaminated area shall be appropriately disposed of or decontaminated.

(k)(2)(iv)

Decontamination procedures shall be monitored by the site safety and health supervisor to determine their effectiveness. When such procedures are found to be ineffective, appropriate steps shall be taken to correct any deficiencies.

(k)(3)

Location. Decontamination shall be performed in geographical areas that will minimize the exposure of uncontaminated employees or equipment to contaminated employees or equipment.

(k)(4)

Equipment and solvents. All equipment and solvents used for decontamination shall be decontaminated or disposed of properly.

(k)(5)

Personal protective clothing and equipment.

(k)(5)(i)

Protective clothing and equipment shall be decontaminated, cleaned, laundered, maintained or replaced as needed to maintain their effectiveness.

(k)(5)(ii)

Employees whose non-impermeable clothing becomes wetted with hazardous substances shall immediately remove that clothing and proceed to shower. The clothing shall be disposed of or decontaminated before it is removed from the work zone.

(k)(6)

Unauthorized employees. Unauthorized employees shall not remove protective clothing or equipment from change rooms.

(k)(7)

Commercial laundries or cleaning establishments. Commercial laundries or cleaning establishments that decontaminate protective clothing or equipment shall be informed of the potentially harmful effects of exposures to hazardous substances.

(k)(8)

Showers and change rooms. Where the decontamination procedure indicates a need for regular showers and change rooms outside of a contaminated area, they shall be provided and meet the requirements of 29 CFR 1910.141. If temperature conditions prevent the effective use of water, then other effective means for cleansing shall be provided and used.

(l) **Emergency response by employees at uncontrolled hazardous waste sites**

(l)(1)

Emergency response plan.

(l)(1)(i)

An emergency response plan shall be developed and implemented by all employers within the scope of paragraphs (a)(1)(i) through (ii) of this section to handle anticipated emergencies prior to the commencement of hazardous waste operations. The plan shall be in writing and available for inspection and copying by employees, their representatives, OSHA personnel and other governmental agencies with relevant responsibilities.

(l)(1)(ii)

Employers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan complying with 1926.35 of this part.

(l)(2)

Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following:

(l)(2)(i)

Pre-emergency planning.

(l)(2)(ii)

Personnel roles, lines of authority, and communication.

(l)(2)(iii)

Emergency recognition and prevention.

(l)(2)(iv)

Safe distances and places of refuge.

(l)(2)(v)

Site security and control.

(l)(2)(vi)

Evacuation routes and procedures.

(l)(2)(vii)

Decontamination procedures which are not covered by the site safety and health plan.

(l)(2)(viii)

Emergency medical treatment and first aid.

(l)(2)(ix)

Emergency alerting and response procedures.

(l)(2)(x)

Critique of response and follow-up.

(l)(2)(xi)

PPE and emergency equipment.

(l)(3)

Procedures for handling emergency incidents.

(l)(3)(i)

In addition to the elements for the emergency response plan required in paragraph (1)(2) of this section, the following elements shall be included for emergency response plans:

(l)(3)(i)(A)

Site topography, layout, and prevailing weather conditions.

(l)(3)(i)(B)

Procedures for reporting incidents to local, state, and federal governmental agencies.

(l)(3)(ii)

The emergency response plan shall be a separate section of the Site Safety and Health Plan.

(l)(3)(iii)

The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.

(l)(3)(iv)

The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(l)(3)(v)

The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(l)(3)(vi)

An employee alarm system shall be installed in accordance with 29 CFR 1926.159 to notify employees of an emergency situation; to stop work activities if necessary; to lower background noise in order to speed communication; and to begin emergency procedures.

(l)(3)(vii)

Based upon the information available at time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

(m) Illumination

Areas accessible to employees shall be lighted to not less than the minimum illumination intensities listed in the following Table D-65.1 while any work is in progress:

TABLE D-65.1 - MINIMUM ILLUMINATION INTENSITIES IN FOOT-CANDLES

Foot-candles	Area or operations
5	General site areas.
3	Excavation and waste areas, access ways, active storage areas, loading platforms, refueling, and field maintenance areas.
5	Indoors: Warehouses, corridors, hallways, and exitways.
5	Tunnels, shafts, and general underground work areas. (Exception: Minimum of 10 foot-candles is required at tunnel and shaft heading during drilling mucking, and scaling. Mine Safety and Health Administration approved cap lights shall be acceptable for use in the tunnel heading.)
10	General shops (e.g., mechanical and electrical equipment rooms, active storerooms, barracks or living quarters, locker or dressing rooms, dining areas, and indoor toilets and workrooms.)
30	First aid stations, infirmaries, and offices.

(n) Sanitation at temporary workplaces

(n)(1)

Potable water.

(n)(1)(i)

An adequate supply of potable water shall be provided on the site.

(n)(1)(ii)

Portable containers used to dispense drinking water shall be capable of being tightly closed, and equipped with a tap. Water shall not be dipped from containers.

(n)(1)(iii)

Any container used to distribute drinking water shall be clearly marked as to the nature of its contents and not used for any other purpose.

(n)(1)(iv)

Where single service cups (to be used but once) are supplied, both a sanitary container for the unused cups and a receptacle for disposing of the used cups shall be provided.

(n)(2)

Nonpotable water.

(n)(2)(i)

Outlets for nonpotable water, such as water for fire fighting purposes, shall be identified to indicate clearly that the water is unsafe and is not to be used for drinking, washing, or cooking purposes.

(n)(2)(ii)

There shall be no cross-connection, open or potential, between a system furnishing potable water and a system furnishing nonpotable water.

(n)(3)

Toilet facilities.

(n)(3)(i)

Toilets shall be provided for employees according to the following Table D-65.2.

TABLE D-65.2 - TOILET FACILITIES

Number of employees	Minimum number of facilities
20 or fewer	One.
More than 20, fewer than 200	One toilet seat and one urinal per 40 employees.
More than 200	One toilet seat and one urinal per 50 employees.

(n)(3)(ii)

Under temporary field conditions, provisions shall be made to assure that at least one toilet facility is available.

(n)(3)(iii)

Hazardous waste sites not provided with a sanitary sewer shall be provided with the following toilet facilities unless prohibited by local codes:

(n)(3)(iii)(A)

Chemical toilets;

(n)(3)(iii)(B)

Recirculating toilets;

(n)(3)(iii)(C)

Combustion toilets; or

(n)(3)(iii)(D)

Flush toilets.

(n)(3)(iv)

The requirements of this paragraph for sanitation facilities shall not apply to mobile crews having transportation readily available to nearby toilet facilities.

(n)(3)(v)

Doors entering toilet facilities shall be provided with entrance locks controlled from inside the facility.

(n)(4)

Food handling. All food service facilities and operations for employees shall meet the applicable laws, ordinances, and regulations of the jurisdictions in which they are located.

(n)(5)

Temporary sleeping quarters. When temporary sleeping quarters are provided, they shall be heated, ventilated, and lighted.

(n)(6)

Washing facilities. The employer shall provide adequate washing facilities for employees engaged in operations where hazardous substances may be harmful to employees. Such facilities shall be in near proximity to the worksite; in areas where exposures are below permissible exposure limits and published exposure levels and which are under the controls of the employer; and shall be so equipped as to enable employees to remove hazardous substances from themselves.

(n)(7)

Showers and change rooms. When hazardous waste clean-up or removal operations commence on a site and the duration of the work will require six months or greater time to complete, the employer shall provide showers and change rooms for all employees exposed to hazardous substances and health hazards involved in hazardous waste clean-up or removal operations.

(n)(7)(i)

Showers shall be provided and shall meet the requirements of 29 CFR 1926.51(f)(4).

(n)(7)(ii)

Change rooms shall be provided and shall meet the requirements of 29 CFR 1926.51(i). Change rooms shall consist of two separate change areas separated by the shower area required in paragraph (n)(7)(i) of this section. One change area, with an exit leading off the worksite, shall provide employees with a clean area where they can remove, store, and put on street clothing. The second area, with an exit to the worksite, shall provide employees with an area where they can put on, remove and store work clothing and personal protective equipment.

(n)(7)(iii)

Showers and change rooms shall be located in areas where exposures are below the permissible exposure limits and published exposure levels. If this cannot be accomplished, then a ventilation system shall be provided that will supply air that is below the permissible exposure limits and published exposure levels.

(n)(7)(iv)

Employers shall assure that employees shower at the end of their work shift and when leaving the hazardous waste site.

(o) **New technology programs**

(o)(1)

The employer shall develop and implement procedures for the introduction of effective new technologies and equipment developed for the improved protection of employees working with hazardous waste clean-up operations, and the same shall be implemented as part of the site safety and health program to assure that employee protection is being maintained.

(o)(2)

New technologies, equipment or control measures available to the industry, such as the use of foams, absorbents, adsorbents, neutralizers, or other means to suppress the level of air contaminates while excavating the site or for spill control, shall be evaluated by employers or their representatives. Such an evaluation shall be done to determine the effectiveness of the new methods, materials, or equipment before implementing their use on a large scale for enhancing employee protection. Information and data from manufacturers or suppliers may be used as part of the employer's evaluation effort. Such evaluations shall be made available to OSHA upon request.

(p) **Certain operations conducted under the Resource Conservation and Recovery Act of 1976 (RCRA**).

Employers conducting operations at treatment, storage and disposal (TSD) facilities specified in paragraph (a)(1)(iv) of this section shall provide and implement the programs specified in this paragraph. See the Notes and Exceptions to paragraph (a)(2)(iii) of this section for employers not covered.

(p)(1)

Safety and health program. The employer shall develop and implement a written safety and health program for employees involved in hazardous waste operations that shall be available for inspection by employees, their representatives and OSHA personnel. The program shall be designed to identify, evaluate and control safety and health hazards in their facilities for the purpose of employee protection, to provide for emergency response meeting the requirements of paragraph (p)(8) of this section and to address as appropriate site analysis, engineering controls, maximum exposure limits, hazardous waste handling procedures and uses of new technologies.

(p)(2)

Hazard communication program. The employer shall implement a hazard communication program meeting the requirements of 29 CFR 1926.59 as part of the employer's safety and program.

Note to 1926.65 - The exemption for hazardous waste provided in 1926.59 is applicable to this section.

(p)(3)

Medical surveillance program. The employer shall develop and implement a medical surveillance program meeting the requirements of paragraph (f) of this section.

(p)(4)

Decontamination program. The employer shall develop and implement a decontamination procedure meeting the requirements of paragraph (k) of this section.

(p)(5)

New technology program. The employer shall develop and implement procedures meeting the requirements of paragraph (o) of this section for introducing new and innovative equipment into the workplace.

(p)(6)

Material handling program. Where employees will be handling drums or containers, the employer shall develop and implement procedures meeting the requirements of paragraphs (j)(1)(ii) through (viii) and (xi) of this section, as well as (j)(3) and (j)(8) of this section prior to starting such work.

(p)(7)

Training program -

(p)(7)(i)

New employees. The employer shall develop and implement a training program, which is part of the employer's safety and health program, for employees exposed to health hazards or hazardous substances at TSD operations to enable the employees to perform their assigned duties and functions in a safe and healthful manner so as not endanger themselves or other employees. The initial training shall be for 24 hours and refresher training shall be for eight hours annually. Employees who have received the initial training required by this paragraph shall be given a written certificate attesting that they have successfully completed the necessary training.

(p)(7)(ii)

Current employees. Employers who can show by an employee's previous work experience and/or training that the employee has had training equivalent to the initial training required by this paragraph, shall be considered as meeting the initial training requirements of this paragraph as to that employee. Equivalent training includes the training that existing employees might have already received from actual site work experience. Current employees shall receive eight hours of refresher training annually.

(p)(7)(iii)

Trainers. Trainers who teach initial training shall have satisfactorily completed a training course for teaching the subjects they are expected to teach or they shall have the academic credentials and instruction experience necessary to demonstrate a good command of the subject matter of the courses and competent instructional skills.

(p)(8)

Emergency response program -

(p)(8)(i)

Emergency response plan. An emergency response plan shall be developed and implemented by all employers. Such plans need not duplicate any of the subjects fully addressed in the employer's contingency planning required by permits, such as those issued by the U.S. Environmental Protection Agency, provided that the contingency plan is made part of the emergency response plan. The emergency response plan shall be a written portion of the employers safety and health program required in paragraph (p)(1) of this section. Employers who will evacuate their employees from the worksite location when an emergency occurs and who do not permit any of their employees to assist in handling the emergency are exempt from the requirements of paragraph (p)(8) if they provide an emergency action plan complying with 1926.35 of this part.

(p)(8)(ii)

Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following areas to the extent that they are not addressed in any specific program required in this paragraph:

(p)(8)(ii)(A)

Pre-emergency planning and coordination with outside parties.

(p)(8)(ii)(B)

Personnel roles, lines of authority, and communication.

(p)(8)(ii)(C)

Emergency recognition and prevention.

(p)(8)(ii)(D)

Safe distances and places of refuge.

(p)(8)(ii)(E)

Site security and control.

(p)(8)(ii)(F)

Evacuation routes and procedures.

(p)(8)(ii)(G)

Decontamination procedures.

(p)(8)(ii)(H)

Emergency medical treatment and first aid.

(p)(8)(ii)(I)

Emergency alerting and response procedures.

(p)(8)(ii)(J)

Critique of response and follow-up.

(p)(8)(ii)(K)

PPE and emergency equipment.

(p)(8)(iii)

Training.

(p)(8)(iii)(A)

Training for emergency response employees shall be completed before they are called upon to perform in real emergencies. Such training shall include the elements of the emergency response plan, standard operating procedures the employer has established for the job, the personal protective equipment to be worn and procedures for handling emergency incidents.

Exception Number 1: An employer need not train all employees to the degree specified if the employer divides the work force in a manner such that a sufficient number of employees who have responsibility to control emergencies have the training specified, and all other employees, who may first respond to an emergency incident, have sufficient awareness training to recognize that an emergency response situation exists and that they are instructed in that case to summon the fully trained employees and not attempt control activities for which they are not trained.

Exception Number 2: An employer need not train all employees to the degree specified if arrangements have been made in advance for an outside fully-trained emergency response team to respond in a reasonable period and all employees, who may come to the incident first, have sufficient awareness training to recognize that an emergency response situation exists and they have been instructed to call the designated outside fully-trained emergency response team for assistance.

(p)(8)(iii)(B)

Employee members of TSD facility emergency response organizations shall be trained to a level of competence in the recognition of health and safety hazards to protect themselves and other employees. This would include training in the methods used to minimize the risk from safety and health hazards; in the safe use of control equipment; in the selection and use of appropriate personal protective equipment; in the safe operating procedures to be used at the incident scene; in the techniques of coordination with other employees to minimize risks; in the appropriate response to over exposure from health hazards or injury to themselves and other employees; and in the recognition of subsequent symptoms which may result from over exposures.

(p)(8)(iii)(C)

The employer shall certify that each covered employee has attended and successfully completed the training required in paragraph (p)(8)(iii) of this section, or shall certify the employee's competency at least yearly. The method used to demonstrate competency for certification of training shall be recorded and maintained by the employer.

(p)(8)(iv)

Procedures for handling emergency incidents.

(p)(8)(iv)(A)

In addition to the elements for the emergency response plan required in paragraph (p)(8)(ii) of this section, the following elements shall be included for emergency response plans to the extent that they do not repeat any information already contained in the emergency response plan:

(p)(8)(iv)(A)(1)

Site topography, layout, and prevailing weather conditions.

(p)(8)(iv)(A)(2)

Procedures for reporting incidents to local, state, and federal governmental agencies.

(p)(8)(iv)(B)

The emergency response plan shall be compatible and integrated with the disaster, fire and/or emergency response plans of local, state, and federal agencies.

(p)(8)(iv)(C)

The emergency response plan shall be rehearsed regularly as part of the overall training program for site operations.

(p)(8)(iv)(D)

The site emergency response plan shall be reviewed periodically and, as necessary, be amended to keep it current with new or changing site conditions or information.

(p)(8)(iv)(E)

An employee alarm system shall be installed in accordance with 29 CFR 1926.159 to notify employees of an emergency situation; to stop work activities if necessary; to lower background noise in order to speed communication; and to begin emergency procedures.

(p)(8)(iv)(F)

Based upon the information available at time of the emergency, the employer shall evaluate the incident and the site response capabilities and proceed with the appropriate steps to implement the site emergency response plan.

(q) Emergency response to hazardous substance releases

This paragraph covers employers whose employees are engaged in emergency response no matter where it occurs except that it does not cover employees engaged in operations specified in paragraphs (a)(1)(i) through (a)(1)(iv) of this section. Those emergency response organizations who have developed and implemented programs equivalent to this paragraph for handling releases of hazardous substances pursuant to section 303 of the Superfund Amendments and Reauthorization Act of 1986 (Emergency Planning and Community Right-to-Know Act of 1986, 42 U.S.C. 11003) shall be deemed to have met the requirements of this paragraph.

(q)(1)

Emergency response plan. An emergency response plan shall be developed and implemented to handle anticipated emergencies prior to the commencement of emergency response operations. The plan shall be in writing and available for inspection and copying by employees, their representatives and OSHA personnel. Employers who will evacuate their employees from the danger area when an emergency occurs, and who do not permit any of their employees to assist in handling the emergency, are exempt from the requirements of this paragraph if they provide an emergency action plan in accordance with 1926.35 of this part.

(q)(2)

Elements of an emergency response plan. The employer shall develop an emergency response plan for emergencies which shall address, as a minimum, the following to the extent that they are not addressed elsewhere:

(q)(2)(i)

Pre-emergency planning and coordination with outside parties.

(q)(2)(ii)

Personnel roles, lines of authority, training, and communication.

(q)(2)(iii)

Emergency recognition and prevention.

(q)(2)(iv)

Safe distances and places of refuge.

(q)(2)(v)

Site security and control.

(q)(2)(vi)

Evacuation routes and procedures.

(q)(2)(vii)

Decontamination.

(q)(2)(viii)

Emergency medical treatment and first aid.

(q)(2)(ix)

Emergency alerting and response procedures.

(q)(2)(x)

Critique of response and follow-up.

(q)(2)(xi)

PPE and emergency equipment.

(q)(2)(xii)

Emergency response organizations may use the local emergency response plan or the state emergency response plan or both, as part of their emergency response plan to avoid duplication. Those items of the emergency response plan that are being properly addressed by the SARA Title III plans may be substituted into their emergency plan or otherwise kept together for the employer and employee's use.

(q)(3)

Procedures for handling emergency response.

(q)(3)(i)

The senior emergency response official responding to an emergency shall become the individual in charge of a site-specific Incident Command System (ICS). All emergency responders and their communications shall be coordinated and controlled through the individual in charge of the ICS assisted by the senior official present for each employer.

Note to (q)(3)(i). - The senior official at an emergency response is the most senior official on the site who has the responsibility for controlling the operations at the site. Initially it is the senior officer on the first-due piece of responding emergency apparatus to arrive on the incident scene. As more senior officers arrive (i.e., battalion chief, fire chief, state law enforcement official, site coordinator, etc.) the position is passed up the line of authority which has been previously established.

(q)(3)(ii)

The individual in charge of the ICS shall identify, to the extent possible, all hazardous substances or conditions present and shall address as appropriate site analysis, use of engineering controls, maximum exposure limits, hazardous substance handling procedures, and use of any new technologies.

(q)(3)(iii)

Based on the hazardous substances and/or conditions present, the individual in charge of the ICS shall implement appropriate emergency operations, and assure that the personal protective equipment worn is appropriate for the hazards to be encountered. However, personal protective equipment shall meet, at a minimum, the criteria contained in 29 CFR 1926.97 when worn while performing fire fighting operations beyond the incipient stage for any incident.

(q)(3)(iv)

Employees engaged in emergency response and exposed to hazardous substances presenting an inhalation hazard or potential inhalation hazard shall wear positive pressure self-contained breathing apparatus while engaged in emergency response, until such time that the individual in charge of the ICS determines through the use of air monitoring that a decreased level of respiratory protection will not result in hazardous exposures to employees.

(q)(3)(v)

The individual in charge of the ICS shall limit the number of emergency response personnel at the emergency site, in those areas of potential or actual exposure to incident or site hazards, to those who are actively performing emergency operations. However, operations in hazardous areas shall be performed using the buddy system in groups of two or more.

(q)(3)(vi)

Back-up personnel shall stand by with equipment ready to provide assistance or rescue. Advance first aid support personnel, as a minimum, shall also stand by with medical equipment and transportation capability.

(q)(3)(vii)

The individual in charge of the ICS shall designate a safety official, who is knowledgeable in the operations being implemented at the emergency response site, with specific responsibility to identify and evaluate hazards and to provide direction with respect to the safety of operations for the emergency at hand.

(q)(3)(viii)

When activities are judged by the safety official to be an IDLH condition and/or to involve an imminent danger condition, the safety official shall have the authority to alter, suspend, or terminate those activities. The safety official shall immediately inform the individual in charge of the ICS of any actions needed to be taken to correct these hazards at the emergency scene.

(q)(3)(ix)

After emergency operations have terminated, the individual in charge of the ICS shall implement appropriate decontamination procedures.

(q)(3)(x)

When deemed necessary for meeting the tasks at hand, approved self-contained compressed air breathing apparatus may be used with approved cylinders from other approved self-contained compressed air breathing apparatus provided that such cylinders are of the same capacity and pressure rating. All compressed air cylinders used with self-contained breathing apparatus shall meet U.S. Department of Transportation and National Institute for Occupational Safety and Health criteria.

(q)(4)

Skilled support personnel. Personnel, not necessarily an employer's own employees, who are skilled in the operation of certain equipment, such as mechanized earth moving or digging equipment or crane and hoisting equipment, and who are needed temporarily to perform immediate emergency support work that cannot reasonably be performed in a timely fashion by an employer's own employees, and who will be or may be exposed to the hazards at an emergency response scene, are not required to meet the training required in this paragraph for the employer's regular employees. However, these personnel shall be given an initial briefing at the site prior to their participation in any emergency response. The initial briefing shall include instruction in the wearing of appropriate personal protective equipment, what chemical hazards are involved, and what duties are to be performed. All other appropriate safety and health precautions provided to the employer's own employees shall be used to assure the safety and health of these personnel.

(q)(5)

Specialist employees. Employees who, in the course of their regular job duties, work with and are trained in the hazards of specific hazardous substances, and who will be called upon to provide technical advice or assistance at a hazardous substance release incident to the individual in charge, shall receive training or demonstrate competency in the area of their specialization annually.

(q)(6)

Training. Training shall be based on the duties and function to be performed by each responder of an emergency response organization. The skill and knowledge levels required for all new responders, those hired after the effective date of this standard, shall be conveyed to them through training before they are permitted to take part in actual emergency operations on an incident. Employees who participate, or are expected to participate, in emergency response, shall be given training in accordance with the following paragraphs:

(q)(6)(i)

First responder awareness level. 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 the authorities of the release. First responders at the awareness level shall have sufficient training or have had sufficient experience to objectively demonstrate competency in the following areas:

(q)(6)(i)(A)

An understanding of what hazardous substances are, and the risks associated with them in an incident.

(q)(6)(i)(B)

An understanding of the potential outcomes associated with an emergency created when hazardous substances are present.

(q)(6)(i)(C)

The ability to recognize the presence of hazardous substances in an emergency.

(q)(6)(i)(D)

The ability to identify the hazardous substances, if possible.

(q)(6)(i)(E)

An understanding of the role of the first responder awareness individual in the employer's emergency response plan including site security and control and the U.S. Department of Transportation's Emergency Response Guidebook.

(q)(6)(i)(F)

The ability to realize the need for additional resources, and to make appropriate notifications to the communication center.

(q)(6)(ii)

First responder operations level. 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, keep it from spreading, and prevent exposures. First responders at the operational level shall have received at least eight hours of training or have had sufficient experience to objectively demonstrate competency in the following areas in addition to those listed for the awareness level and the employer shall so certify:

(q)(6)(ii)(A)

Knowledge of the basic hazard and risk assessment techniques.

(q)(6)(ii)(B)

Know how to select and use proper personal protective equipment provided to the first responder operational level.

(q)(6)(ii)(C)

An understanding of basic hazardous materials terms.

(q)(6)(ii)(D)

Know how to perform basic control, containment and/or confinement operations within the capabilities of the resources and personal protective equipment available with their unit.

(q)(6)(ii)(E)

Know how to implement basic decontamination procedures.

(q)(6)(ii)(F)

An understanding of the relevant standard operating procedures and termination procedures.

(q)(6)(iii)

Hazardous materials technician. Hazardous materials 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 release in order to plug, patch or otherwise stop the release of a hazardous substance. Hazardous materials technicians shall have received at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(q)(6)(iii)(A)

Know how to implement the employer's emergency response plan.

(q)(6)(iii)(B)

Know the classification, identification and verification of known and unknown materials by using field survey instruments and equipment.

(q)(6)(iii)(C)

Be able to function within an assigned role in the Incident Command System.

(q)(6)(iii)(D)

Know how to select and use proper specialized chemical personal protective equipment provided to the hazardous materials technician.

(q)(6)(iii)(E)

Understand hazard and risk assessment techniques.

(q)(6)(iii)(F)

Be able to perform advance control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available with the unit.

(q)(6)(iii)(G)

Understand and implement decontamination procedures.

(q)(6)(iii)(H)

Understand termination procedures.

(q)(6)(iii)(I)

Understand basic chemical and toxicological terminology and behavior.

(q)(6)(iv)

Hazardous materials specialist. Hazardous materials specialists are individuals who respond with and provide support to hazardous materials technicians. Their duties parallel those of the hazardous materials technician, however, those duties require a more directed or specific knowledge of the various 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 government authorities in regards to site activities. Hazardous materials specialists shall have received at least 24 hours of training equal to the technician level and in addition have competency in the following areas and the employer shall so certify:

(q)(6)(iv)(A)

Know how to implement the local emergency response plan.

(q)(6)(iv)(B)

Understand classification, identification and verification of known and unknown materials by using advanced survey instruments and equipment.

(q)(6)(iv)(C)

Know of the state emergency response plan.

(q)(6)(iv)(D)

Be able to select and use proper specialized chemical personal protective equipment provided to the hazardous materials specialist.

(q)(6)(iv)(E)

Understand in-depth hazard and risk techniques.

(q)(6)(iv)(F)

Be able to perform specialized control, containment, and/or confinement operations within the capabilities of the resources and personal protective equipment available.

(q)(6)(iv)(G)

Be able to determine and implement decontamination procedures.

(q)(6)(iv)(H)

Have the ability to develop a site safety and control plan.

(q)(6)(iv)(I)

Understand chemical, radiological and toxicological terminology and behavior.

(q)(6)(v)

On scene incident commander. Incident commanders, who will assume control of the incident scene beyond the first responder awareness level, shall receive at least 24 hours of training equal to the first responder operations level and in addition have competency in the following areas and the employer shall so certify:

(q)(6)(v)(A)

Know and be able to implement the employer's incident command system.

(q)(6)(v)(B)

Know how to implement the employer's emergency response plan.

(q)(6)(v)(C)

Know and understand the hazards and risks associated with employees working in chemical protective clothing.

(q)(6)(v)(D)

Know how to implement the local emergency response plan.

(q)(6)(v)(E)

Know of the state emergency response plan and of the Federal Regional Response Team.

(q)(6)(v)(F)

Know and understand the importance of decontamination procedures.

(q)(7)

Trainers. Trainers who teach any of the above training subjects shall have satisfactorily completed a training course for teaching the subjects they are expected to teach, such as the courses offered by the U.S. National Fire Academy, or they shall have the training and/or academic credentials and instructional experience necessary to demonstrate competent instructional skills and a good command of the subject matter of the courses they are to teach.

(q)(8)

Refresher training.

(q)(8)(i)

Those employees who are trained in accordance with paragraph (q)(6) of this section shall receive annual refresher training of sufficient content and duration to maintain their competencies, or shall demonstrate competency in those areas at least yearly.

(q)(8)(ii)

A statement shall be made of the training or competency, and if a statement of competency is made, the employer shall keep a record of the methodology used to demonstrate competency.

(q)(9)

Medical surveillance and consultation.

(q)(9)(i)

Members of an organized and designated HAZMAT team and hazardous materials specialists shall receive a baseline physical examination and be provided with medical surveillance as required in paragraph (f) of this section.

(q)(9)(ii)

Any emergency response employees who exhibits signs or symptoms which may have resulted from exposure to hazardous substances during the course of an emergency incident, either immediately or subsequently, shall be provided with medical consultation as required in paragraph (f)(3)(ii) of this section.

(q)(10)

Chemical protective clothing. Chemical protective clothing and equipment to be used by organized and designated HAZMAT team members, or to be used by hazardous materials specialists, shall meet the requirements of paragraphs (g)(3) through (5) of this section.

(q)(11)

Post-emergency response operations. Upon completion of the emergency response, if it is determined that it is necessary to remove hazardous substances, health hazards, and materials contaminated with them (such as contaminated soil or other elements of the natural environment) from the site of the incident, the employer conducting the clean-up shall comply with one of the following:

(q)(11)(i)

Meet all of the requirements of paragraphs (b) through (o) of this section; or

(q)(11)(ii)

Where the clean-up is done on plant property using plant or workplace employees, such employees shall have completed the training requirements of the following: 29 CFR 1926.35, 1926.59, and 1926.103, and other appropriate safety and health training made necessary by the tasks that they are expected to be performed such as personal protective equipment and decontamination procedures. All equipment to be used in the performance of the clean-up work shall be in serviceable condition and shall have been inspected prior to use.

[58 FR 35129, June 30, 1993; 61 FR 5507, Feb. 13, 1996]

OSHA Hazard Communication Standard (HazCom)

29 CFR 1910.120 (excerpted)

Note: This standard is included by reference in the Construction Standards at 29 CFR 1926.59 and is therefore fully applicable to construction workplaces. Sections of the standard that do not directly apply to workplaces have been omitted in his appendix.

Table of Contents

(a) "Purpose."

The purpose of this section is to ensure that the hazards of all chemicals produced or imported are evaluated, and that information concerning their hazards is transmitted to employers and employees. This transmittal of information is to be accomplished by means of comprehensive hazard communication programs, which are to include container labeling and other forms of warning, material safety data sheets and employee training.

(a)(2)

This occupational safety and health standard is intended to address comprehensively the issue of evaluating the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees, and to preempt any legal requirements of a state, or political subdivision of a state, pertaining to this subject. Evaluating the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees, may include, for example, but is not limited to, provisions for: developing and maintaining a written hazard communication program for the workplace, including lists of hazardous chemicals present; labeling of containers of chemicals in the workplace, as well as of containers of chemicals being shipped to other workplaces; preparation and distribution of material safety data sheets to employees and downstream employers; and development and implementation of employee training programs regarding hazards of chemicals and protective measures. Under section 18 of the Act, no state or political subdivision of a state may adopt or enforce, through any court or agency, any requirement relating to the issue addressed by this Federal standard, except pursuant to a Federally-approved state plan.

(b) "Scope and application."

(b)(1)

This section requires chemical manufacturers or importers to assess the hazards of chemicals which they produce or import, and all employers to provide information to their employees about the hazardous chemicals to which they are exposed, by means of a hazard communication program, labels and other forms of warning, material safety data sheets, and information and training. In addition, this section requires distributors to transmit the required information to employers. (Employers who do not produce or import chemicals need only focus on those parts of this rule that deal with establishing a workplace program and communicating information to their workers. Appendix E of this section is a general guide for such employers to help them determine their compliance obligations under the rule.)

(b)(2)

This section applies to any chemical which is known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency.

(b)(3)

This section applies to laboratories only as follows:

(b)(3)(i)

Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

(b)(3)(ii)

Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible during each workshift to laboratory employees when they are in their work areas;

(b)(3)(iii)

Employers shall ensure that laboratory employees are provided information and training in accordance with paragraph (h) of this section, except for the location and availability of the written hazard communication program under paragraph (h)(2)(iii) of this section; and,

(b)(3)(iv)

Laboratory employers that ship hazardous chemicals are considered to be either a chemical manufacturer or a distributor under this rule, and thus must ensure that any containers of hazardous chemicals leaving the laboratory are labeled in accordance with paragraph (f)(1) of this section, and that a material safety data sheet is provided to distributors and other employers in accordance with paragraphs (g)(6) and (g)(7) of this section.

(b)(4)

In work operations where employees only handle chemicals in sealed containers which are not opened under normal conditions of use (such as are found in marine cargo handling, warehousing, or retail sales), this section applies to these operations only as follows:

(b)(4)(i)

Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

(b)(4)(ii)

Employers shall maintain copies of any material safety data sheets that are received with incoming shipments of the sealed containers of hazardous chemicals, shall obtain a material safety data sheet as soon as possible for sealed containers of hazardous chemicals received without a material safety data sheet if an employee requests the material safety data sheet, and shall ensure that the material safety data sheets are readily accessible during each work shift to employees when they are in their work area(s); and,

(b)(4)(iii)

Employers shall ensure that employees are provided with information and training in accordance with paragraph (h) of this section (except for the location and availability of the written hazard communication program under paragraph (h)(2)(iii) of this section), to the extent necessary to protect them in the event of a spill or leak of a hazardous chemical from a sealed container.

(b)(5)

This section does not require labeling of the following chemicals:

(b)(5)(i)

Any pesticide as such term is defined in the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136 et seq.), when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Environmental Protection Agency;

(b)(5)(ii)

Any chemical substance or mixture as such terms are defined in the Toxic Substances Control Act (15 U.S.C. 2601 et seq.), when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Environmental Protection Agency;

(b)(5)(iii)

Any food, food additive, color additive, drug, cosmetic, or medical or veterinary device or product, including materials intended for use as ingredients in such products (e.g. flavors and fragrances), as such terms are defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.) or the Virus-Serum-Toxin Act of 1913 (21 U.S.C. 151 et seq.), and regulations issued under those Acts, when they are subject to the labeling requirements under those Acts by either the Food and Drug Administration or the Department of Agriculture;

(b)(5)(iv)

Any distilled spirits (beverage alcohols), wine, or malt beverage intended for nonindustrial use, as such terms are defined in the Federal Alcohol Administration Act (27 U.S.C. 201 et seq.) and regulations issued under that Act, when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Bureau of Alcohol, Tobacco, and Firearms;

(b)(5)(v)

Any consumer product or hazardous substance as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq.) and Federal Hazardous Substances Act (15 U.S.C. 1261 et seq.) respectively, when subject to a consumer product safety standard or labeling requirement of those Acts, or regulations issued under those Acts by the Consumer Product Safety Commission; and,

(b)(5)(vi)

Agricultural or vegetable seed treated with pesticides and labeled in accordance with the Federal Seed Act (7 U.S.C. 1551 et seq.) and the labeling regulations issued under that Act by the Department of Agriculture.

(b)(6)

This section does not apply to:

(b)(6)(i)

Any hazardous waste as such term is defined by the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6901 et seq.), when subject to regulations issued under that Act by the Environmental Protection Agency;

(b)(6)(ii)

Any hazardous substance as such term is defined by the Comprehensive Environmental Response, Compensation and Liability ACT (CERCLA) (42 U.S.C. 9601 et seq.) when the hazardous substance is the focus of remedial or removal action being conducted under CERCLA in accordance with the Environmental Protection Agency regulations.

(b)(6)(iii)

Tobacco or tobacco products;

(b)(6)(iv)

Wood or wood products, including lumber which will not be processed, where the chemical manufacturer or importer can establish that the only hazard they pose to employees is the potential for flammability or combustibility (wood or wood products which have been treated with a hazardous chemical covered by this standard, and wood which may be subsequently sawed or cut, generating dust, are not exempted);

(b)(6)(v)

Articles (as that term is defined in paragraph (c) of this section);

(b)(6)(vi)

Food or alcoholic beverages which are sold, used, or prepared in a retail establishment (such as a grocery store, restaurant, or drinking place), and foods intended for personal consumption by employees while in the workplace;

(b)(6)(vii)

Any drug, as that term is defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.), when it is in solid, final form for direct administration to the patient (e.g., tablets or pills); drugs which are packaged by the chemical manufacturer for sale to consumers in a retail establishment (e.g., over-the-counter drugs); and drugs intended for personal consumption by employees while in the workplace (e.g., first aid supplies);

(b)(6)(viii)

Cosmetics which are packaged for sale to consumers in a retail establishment, and cosmetics intended for personal consumption by employees while in the workplace;

(b)(6)(ix)

Any consumer product or hazardous substance, as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq.) and Federal Hazardous Substances Act (15 U.S.C. 1261 et seq.) respectively, where the employer can show that it is used in the workplace for the purpose intended by the chemical manufacturer or importer of the product, and the use results in a duration and frequency of exposure which is not greater than the range of exposures that could reasonably be experienced by consumers when used for the purpose intended;

(b)(6)(x)

Nuisance particulates where the chemical manufacturer or importer can establish that they do not pose any physical or health hazard covered under this section;

(b)(6)(xi)

Ionizing and non-ionizing radiation; and,

(b)(6)(xii)

Biological hazards.

(c) omitted

(d) omitted

(e) "Written hazard communication program."

(e)(1)

Employers shall develop, implement, and maintain at each workplace, a written hazard communication program which at least describes how the criteria specified in paragraphs (f), (g), and (h) of this section for labels and other forms of warning, material safety data sheets, and employee information and training will be met, and which also includes the following:

(e)(1)(i)

A list of the hazardous chemicals known to be present using an identity that is referenced on the appropriate material safety data sheet (the list may be compiled for the workplace as a whole or for individual work areas); and,

(e)(1)(ii)

The methods the employer will use to inform employees of the hazards of non-routine tasks (for example, the cleaning of reactor vessels), and the hazards associated with chemicals contained in unlabeled pipes in their work areas.

(e)(2)

"Multi-employer workplaces." Employers who produce, use, or store hazardous chemicals at a workplace in such a way that the employees of other employer(s) may be exposed (for example, employees of a construction contractor working on-site) shall additionally ensure that the hazard communication programs developed and implemented under this paragraph (e) include the following:

(e)(2)(i)

The methods the employer will use to provide the other employer(s) on-site access to material safety data sheets for each hazardous chemical the other employer(s)' employees may be exposed to while working;

(e)(2)(ii)

The methods the employer will use to inform the other employer(s) of any precautionary measures that need to be taken to protect employees during the workplace's normal operating conditions and in foreseeable emergencies; and,

(e)(2)(iii)

The methods the employer will use to inform the other employer(s) of the labeling system used in the workplace.

(e)(3)

The employer may rely on an existing hazard communication program to comply with these requirements, provided that it meets the criteria established in this paragraph (e).

(e)(4)

The employer shall make the written hazard communication program available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director, in accordance with the requirements of 29 CFR 1910.1020 (e).

(e)(5)

Where employees must travel between workplaces during a workshift, i.e., their work is carried out at more than one geographical location, the written hazard communication program may be kept at the primary workplace facility.

(f) "Labels and other forms of warning."

(f)(1)

The chemical manufacturer, importer, or distributor shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged or marked with the following information:

(f)(1)(i)

Identity of the hazardous chemical(s);

(f)(1)(ii)

Appropriate hazard warnings; and

(f)(1)(iii)

Name and address of the chemical manufacturer, importer, or other responsible party.

(f)(2)(i)

For solid metal (such as a steel beam or a metal casting), solid wood, or plastic items that are not exempted as articles due to their downstream use, or shipments of whole grain, the required label may be transmitted to the customer at the time of the initial shipment, and need not be included with subsequent shipments to the same employer unless the information on the label changes;

(f)(2)(ii)

The label may be transmitted with the initial shipment itself, or with the material safety data sheet that is to be provided prior to or at the time of the first shipment; and,

(f)(2)(iii)

This exception to requiring labels on every container of hazardous chemicals is only for the solid material itself, and does not apply to hazardous chemicals used in conjunction with, or known to be present with, the material and to which employees handling the items in transit may be exposed (for example, cutting fluids or pesticides in grains).

(f)(3)

Chemical manufacturers, importers, or distributors shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged, or marked in accordance with this section in a manner which does not conflict with the requirements of the Hazardous Materials Transportation Act (49 U.S.C. 1801 et seq.) and regulations issued under that Act by the Department of Transportation.

(f)(4)

If the hazardous chemical is regulated by OSHA in a substance-specific health standard, the chemical manufacturer, importer, distributor or employer shall ensure that the labels or other forms of warning used are in accordance with the requirements of that standard.

(f)(5)

Except as provided in paragraphs (f)(6) and (f)(7) of this section, the employer shall ensure that each container of hazardous chemicals in the workplace is labeled, tagged or marked with the following information:

(f)(5)(i)

Identity of the hazardous chemical(s) contained therein; and,

(f)(5)(ii)

Appropriate hazard warnings, or alternatively, words, pictures, symbols, or combination thereof, which provide at least general information regarding the hazards of the chemicals, and which, in conjunction with the other information immediately available to employees under the hazard communication program, will provide employees with the specific information regarding the physical and health hazards of the hazardous chemical.

(f)(6)

The employer may use signs, placards, process sheets, batch tickets, operating procedures, or other such written materials in lieu of affixing labels to individual stationary process containers, as long as the alternative method identifies the containers to which it is applicable and conveys the information required by paragraph (f)(5) of this section to be on a label. The written materials shall be readily accessible to the employees in their work area throughout each work shift.

(f)(7)

The employer is not required to label portable containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for the immediate use of the employee who performs the transfer. For purposes of this section, drugs which are dispensed by a pharmacy to a health care provider for direct administration to a patient are exempted from labeling.

(f)(8)

The employer shall not remove or deface existing labels on incoming containers of hazardous chemicals, unless the container is immediately marked with the required information.

(f)(9)

The employer shall ensure that labels or other forms of warning are legible, in English, and prominently displayed on the container, or readily available in the work area throughout each work shift. Employers having employees who speak other languages may add the information in their language to the material presented, as long as the information is presented in English as well.

(f)(10)

The chemical manufacturer, importer, distributor or employer need not affix new labels to comply with this section if existing labels already convey the required information.

(f)(11)

Chemical manufacturers, importers, distributors, or employers who become newly aware of any significant information regarding the hazards of a chemical shall revise the labels for the chemical within three months of becoming aware of the new information. Labels on containers of hazardous chemicals shipped after that time shall contain the new information. If the chemical is not currently produced or imported, the chemical manufacturer, importers, distributor, or employer shall add the information to the label before the chemical is shipped or introduced into the workplace again.

(g) "Material safety data sheets."

(g)(1)

Chemical manufacturers and importers shall obtain or develop a material safety data sheet for each hazardous chemical they produce or import. Employers shall have a material safety data sheet in the workplace for each hazardous chemical which they use.

(g)(2)

Each material safety data sheet shall be in English (although the employer may maintain copies in other languages as well), and shall contain at least the following information:

(g)(2)(i)

The identity used on the label, and, except as provided for in paragraph (i) of this section on trade secrets:

(g)(2)(i)(A)

If the hazardous chemical is a single substance, its chemical and common name(s);

(g)(2)(i)(B)

If the hazardous chemical is a mixture which has been tested as a whole to determine its hazards, the chemical and common name(s) of the ingredients which contribute to these known hazards, and the common name(s) of the mixture itself; or,

(g)(2)(i)(C)

If the hazardous chemical is a mixture which has not been tested as a whole:

(g)(2)(i)(C)(1)

The chemical and common name(s) of all ingredients which have been determined to be health hazards, and which comprise 1% or greater of the composition, except that chemicals identified as carcinogens under paragraph (d) of this section shall be listed if the concentrations are 0.1% or greater; and,

(g)(2)(i)(C)(2)

The chemical and common name(s) of all ingredients which have been determined to be health hazards, and which comprise less than 1% (0.1% for carcinogens) of the mixture, if there is evidence that the ingredient(s) could be released from the mixture in concentrations which would exceed an established OSHA permissible exposure limit or ACGIH Threshold Limit Value, or could present a health risk to employees; and,

(g)(2)(i)(C)(3)

The chemical and common name(s) of all ingredients which have been determined to present a physical hazard when present in the mixture;

(g)(2)(ii)

Physical and chemical characteristics of the hazardous chemical (such as vapor pressure, flash point);

(g)(2)(iii)

The physical hazards of the hazardous chemical, including the potential for fire, explosion, and reactivity;

(g)(2)(iv)

The health hazards of the hazardous chemical, including signs and symptoms of exposure, and any medical conditions which are generally recognized as being aggravated by exposure to the chemical;

(g)(2)(v)

The primary route(s) of entry;

(g)(2)(vi)

The OSHA permissible exposure limit, ACGIH Threshold Limit Value, and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the material safety data sheet, where available;

(g)(2)(vii)

Whether the hazardous chemical is listed in the National Toxicology Program (NTP) Annual Report on Carcinogens (latest edition) or has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest editions), or by OSHA;

(g)(2)(viii)

Any generally applicable precautions for safe handling and use which are known to the chemical manufacturer, importer or employer preparing the material safety data sheet, including appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for clean-up of spills and leaks;

(g)(2)(ix)

Any generally applicable control measures which are known to the chemical manufacturer, importer or employer preparing the material safety data sheet, such as appropriate engineering controls, work practices, or personal protective equipment;

(g)(2)(x)

Emergency and first aid procedures;

(g)(2)(xi)

The date of preparation of the material safety data sheet or the last change to it; and,

(g)(2)(xii)

The name, address and telephone number of the chemical manufacturer, importer, employer or other responsible party preparing or distributing the material safety data sheet, who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

(g)(3)

If no relevant information is found for any given category on the material safety data sheet, the chemical manufacturer, importer or employer preparing the material safety data sheet shall mark it to indicate that no applicable information was found.

(g)(4)

Where complex mixtures have similar hazards and contents (i.e. the chemical ingredients are essentially the same, but the specific composition varies from mixture to mixture), the chemical manufacturer, importer or employer may prepare one material safety data sheet to apply to all of these similar mixtures.

(g)(5)

The chemical manufacturer, importer or employer preparing the material safety data sheet shall ensure that the information recorded accurately reflects the scientific evidence used in making the hazard determination. If the chemical manufacturer, importer or employer preparing the material safety data sheet becomes newly aware of any significant information regarding the hazards of a chemical, or ways to protect against the hazards, this new information shall be added to the material safety data sheet within three months. If the chemical is not currently being produced or imported the chemical manufacturer or importer shall add the information to the material safety data sheet before the chemical is introduced into the workplace again.

(g)(6) omitted

(g)(6)(i)

Chemical manufacturers or importers shall ensure that distributors and employers are provided an appropriate material safety data sheet with their initial shipment, and with the first shipment after a material safety data sheet is updated;

(g)(6)(ii)

The chemical manufacturer or importer shall either provide material safety data sheets with the shipped containers or send them to the distributor or employer prior to or at the time of the shipment;

(g)(6)(iii)

If the material safety data sheet is not provided with a shipment that has been labeled as a hazardous chemical, the distributor or employer shall obtain one from the chemical manufacturer or importer as soon as possible; and,

(g)(6)(iv)

The chemical manufacturer or importer shall also provide distributors or employers with a material safety data sheet upon request.

(g)(7)(i)omitted

(g)(8)

The employer shall maintain in the workplace copies of the required material safety data sheets for each hazardous chemical, and shall ensure that they are readily accessible during each work shift to employees when they are in their work area(s). (Electronic access, microfiche, and other alternatives to maintaining paper copies of the material safety data sheets are permitted as long as no barriers to immediate employee access in each workplace are created by such options.)

(g)(9)

Where employees must travel between workplaces during a workshift, i.e., their work is carried out at more than one geographical location, the material safety data sheets may be kept at the primary workplace facility. In this situation, the employer shall ensure that employees can immediately obtain the required information in an emergency.

(g)(10)

Material safety data sheets may be kept in any form, including operating procedures, and may be designed to cover groups of hazardous chemicals in a work area where it may be more appropriate to address the hazards of a process rather than individual hazardous chemicals. However, the employer shall ensure that in all cases the required information is provided for each hazardous chemical, and is readily accessible during each work shift to employees when they are in in their work area(s).

(g)(11)

Material safety data sheets shall also be made readily available, upon request, to designated representatives and to the Assistant Secretary, in accordance with the requirements of 29 CFR 1910.1020(e). The Director shall also be given access to material safety data sheets in the same manner.

(h) "Employee information and training."

(h)(1)

Employers shall provide employees with effective information and training on hazardous chemicals in their work area at the time of their initial assignment, and whenever a new physical or health hazard the employees have not previously been trained about is introduced into their work area. Information and training may be designed to cover categories of hazards (e.g., flammability, carcinogenicity) or specific chemicals. Chemical-specific information must always be available through labels and material safety data sheets.

(h)(2)

"Information." Employees shall be informed of:

(h)(2)(i)

The requirements of this section;

(h)(2)(ii)

Any operations in their work area where hazardous chemicals are present; and,

(h)(2)(iii)

The location and availability of the written hazard communication program, including the required list(s) of hazardous chemicals, and material safety data sheets required by this section.

(h)(3)

"Training." Employee training shall include at least:

(h)(3)(i)

Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

(h)(3)(ii)

The physical and health hazards of the chemicals in the work area;

(h)(3)(iii)

The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and,

(h)(3)(iv)

The details of the hazard communication program developed by the employer, including an explanation of the labeling system and the material safety data sheet, and how employees can obtain and use the appropriate hazard information.

(i) omitted.

(j) omitted

Appendix A.3

OSHA Regulations (Standards-29 CFR)
General Description and Discussion of the Levels of Protection and Protective Gear-1926.65 App B

- **Standard Number:** 1926.65 App B
- **Standard Title:** General Description and Discussion of the Levels of Protection and Protective Gear
- **SubPart Number:** D
- **SubPart Title:** Occupational Health and Environmental Controls

This appendix sets forth information about personal protective equipment (PPE) protection levels which may be used to assist employers in complying with the PPE requirements of this section.

As required by the standard, PPE must be selected which will protect employees from the specific hazards which they are likely to encounter during their work on-site.

Selection of the appropriate PPE is a complex process which should take into consideration a variety of factors. Key factors involved in this process are identification of the hazards, or suspected hazards; their routes of potential hazard to employees (inhalation, skin absorption, ingestion, and eye or skin contact); and the performance of the PPE materials (and seams) in providing a barrier to these hazards. The amount of protection provided by PPE is material-hazard specific. That is, protective equipment materials will protect well against some hazardous substances and poorly, or not at all, against others. In many instances, protective equipment materials cannot be found which will provide continuous protection from the particular hazardous substance. In these cases the breakthrough time of the protective material should exceed the work durations.

Other factors matching the PPE to the employee's work requirements and task-specific conditions. The durability of PPE materials, such as tear strength and seam strength, should be considered in relation to the employee's tasks. The effects of PPE in relation to heat stress and task duration are a factor in selecting and using PPE. In some cases layers of PPE may be necessary to provide sufficient protection, or to protect expensive PPE inner garments, suits or equipment.

The more that is known about the hazards at the site, the easier the job of PPE selection becomes. As more information about the hazards and conditions at the site becomes available, the sit supervisor can make decisions to up-grade or down-grade the level of PPE protection to match the tasks at hand.

The following are guidelines which and employer can use to begin the selection of the appropriate PPE. As noted above, the site information may suggest the use of combinations of PPE selected from the different protection levels (i.e.,A, B, C, or D) as being more suitable to the hazards of the work. It should be cautioned that the listing below does not fully address the performance of the specific PPE material in relation to the specific hazards at the job site, and that PPE selection, evaluation and re-selection is an ongoing process until sufficient information about the hazards and PPE performance is obtained.

Appendix A.3

Part A. Personal protective equipment is divided into four categories based on the degree of protection afforded. (See Part B of this appendix for further explanation of Levels A, B, C, and D hazards.)

I. Level A - To be selected when the greates level of skin, respiratory, and eye protection is required.

The following constitute Level A equipment; it may be used as appropriate;

1. Positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by the National Institute for Occupational Safety and Health (NIOSH).

2. Totally-encapsulating chemical-protective suit.

3. Coveralls. (1)

4. Long underwear. (1)

5. Gloves, outer, chemical-resistant.

6. Gloves, inner, chemical-resistant.

7. boots, chemical-resistant, steel toe and shank.

8. Hard hat (under suit). (1)

9. Disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit).

II. Level B - The highest level of respiratory protection is necessary but a lesser level of skin protection is needed.
The following constitute Level B equipment; it may be used as appropriate.

1. Positive pressure , full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved).

2. Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls).

3. Coveralls. (1)

4. Gloves, outer, chemical-resistant.

5. Gloves, inner, chemical-resistant.

6. Boots, outer, chemical-resistant steel toe and shank

7. Boot-covers, outer, chemical-resistant (disposable). (1)

8. Hard hat. (1)

9. [Reserved]

10. Face shield. (1)

III. Level C - The concentration(s) and type(s) of airborne substance(s) is known and the criteria for using air purifying respirators are met.

The following constitute Level C equipment; it may be used as appropriate.

1. Full-face or half-mask, air purifying respirators (NIOSH approved).

2. Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls).

3. Coveralls. (1)

4. Gloves, outer, chemical-resistant.

5. Gloves, inner, chemical-resistant.
6. Boots (outer), chemical-resistant steel toe and shank (1)

7. Boot-covers, outer, chemical-resistant (disposable). (1)

8. Hard hat. (1)

9. Escape mask. (1)

10. Face shield. (1)

IV. Level D - A work uniform affording minimal protection, used for nuisance contamination only.

The following constitute Level D equipment; it may be used as appropriate:

1. Coveralls.

2. Gloves. (1)

3. Boots/shoes, chemical-resistant steel toe and shank.

4. Boots, outer, chemical-resistant (disposable. (1)

5. Safety glasses of chemical splash goggles*.

6. Hard hat. (1)

7. Escape mask. (1)

8. Face shield. (1)

*optional, as applicable

Part B. The types of hazards for which levels A, B, C, and D protection are appropriate are described below:

I. Level A - Level A protection should be used when:

1. The hazardous substance has been identified and requires the highest level of protection for skin, eyes, and the respiratory system based on either the measured (or potential for) high concentration of atmospheric vapors, gases, or particulates; or the site operations and work functions involve a high potential for splash, immersion, or exposure to unexpected vapors, gases, or particulates of materials that are harmful to skin or capable of being absorbed through the skin;

2. Substances with a high degree of hazard to the skin are known or suspected to be present, and skin contact is possible; or

3. Operations are being conducted in confined, poorly ventilated areas, and the absence of condition requiring Level A have not yet been determined.

II. Level B - Level B protection should be used when:

1. The type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection;

2. The atmosphere contains less than 19.5 percent oxygen; or

3. The presence of incompletely identified vapors or gases is indicated by a direct-reading organic vapor detection instrument, but vapors and gases are not suspected of containing high levels of chemicals harmful to skin or capable of being absorbed through the skin.

Note: This involves atmospheres with IDLH concentrations of specific substances that present severe inhalation hazards and that do not represent a severe skin hazard; or that do not meet the criteria for use of air-purifying respirators.

III. Level C - Level C protection should be used when:

1. The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect of be absorbed through any exposed skin;

2. The types of air contaminants have been identified, concentrations measured, and an air-purifying respirator is available that can remove the contaminants; and

3. All criteria for the use of air-purifying respirators are met.

IV. Level D - Level D protection should be used when:

1. The atmosphere contains no known hazard; and

2. Work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

Note: As stated before, combinations of personal protective equipment other than those described for Levels a, B, C, and D protection may be more appropriate and may be used to provide the proper level of protection.

As an aid in selecting suitable chemical protective clothing, it should be noted that the National Fire Protection Association (NFPA) has developed standards on chemical protective clothing. The standards that have been adopted by include:

NFPA 1991- Standard on Vapor-Protective Suits for Hazardous Chemical Emergencies (EPA Level A Protective Clothing) NFPA 1992 - Standard on Liquid Splash-Protective Suits for Hazardous Chemical Emergencies (EPA Level B Protective Clothing) NFPA 1993 - Standard on Liquid Splash-Protective Suits for Non-emergency,

Non-flammable Hazardous Chemical Situations (EPA Level B Protective Clothing)

These standard apply documentation and performance requirements to the manufacture of chemical protective suits. Chemical protective suits meeting these requirements are labeled as compliant with the appropriate standard. It is recommended that chemical protective suits that meet these standards be used.

[58 FR 35144, June 30, 1993; 59 FR 43268, Aug. 22, 1994]

Appendix A

HOW TO READ OSHA STANDARDS

- All OSHA Standards are composed of paragraphs. OSHA Paragraphs begin with small letters (a), (b), (c) etc.,

  for example, the OSHA Hazard Communication Standard 29 CFR 1910.1200 has paragraphs (a) through (j)

- Sub-sections of the paragraphs begin with regular (Arabic) numbers (1), (2), (3) etc.

  for example, 1910.1200 (a)(1)

- Sub-sections of the numbered sub-sections begin with lower case Roman numeral (i)(ii) (iii)(iv)(v) etc.,

  for example, 1910.1200 (b)(3)(i)

- When the Roman numeral sub-sections have sub-sections they begin with capital letters (A), (B), (C) etc,. This doesn't happen very often, and some formats use small letters instead of capitals.

  for example, (a) (1) (i) (A) or 1910.1200 (i) (3) (ii) (a)

the general pattern is:
(a)(1)(i)(A)

little letter - Arabic numeral- small Roman numeral - capital letter

Appendix B

OSHA REGIONAL OFFICES

NOTE: In case of a workplace fatality/explosion/emergency call OSHA at 1-800-321-6742

Region 1: CT, ME, MA, NH, RI, VT
U.S. Department of Labor—OSHA
JFK Federal Bldg. Rm. E340
Boston, MA 02203
Phone: (617) 565–9860
Fax: (617) 565–9827

Region 2: NJ, NY, PR
U.S. Department of Labor—OSHA
201 Varick St., Rm. 670
New York, NY 10014
Phone: (212) 337–2378
Fax: (212) 337–2371

Region 3: DE, DC, MD, PA, VA, WV
U.S. Department of Labor—OSHA
The Curtis Center
170 S. Independence Mall West
Suite 740 West
Philadelphia, PA 19106-3309
Phone: (215) 861-4900
Fax: (215) 861-4904

Region 4: AL, FL, GA, KY, MI, NC, SC, TN
U.S. Department of Labor—OSHA
61 Forsyth St., SW
Atlanta, GA 30303
Phone: (404) 562–2300
Fax: (404) 562–2295

Region 5: IN, IL, MI, MN, OH, WI
U.S. Department of Labor—OSHA
230 S. Dearborn St., Rm. 3244
Chicago, IL 60604
Phone: (312) 353–2220
Fax: (312) 353–7774

Region 6: AR, LA, NM, OK, TX
U.S. Department of Labor—OSHA
525 Griffin St., Rm. 602
Dallas, TX 75202
Phone: (214) 767–4731
Fax: (214) 767–4137

Region 7: IA, KS, MO, NE
U.S. Department of Labor—OSHA
City Center Square
1100 Main St., Ste. 800
Kansas City, MO 64105
Phone: (816) 426–5861
Fax: (816) 426–2750

Region 8: CO, MT, ND, SD, UT, WY
U.S. Department of Labor—OSHA
1999 Broadway, Ste. 1690
Denver, CO 80202-5716
Phone: (303) 844–1600
Fax: (303) 844–1616

Region 9: AZ, CA, HI, NV, American Samoa, Guam, Trust Territory of Pacific Islands
U.S. Department of Labor—OSHA
71 Stevenson St., Rm. 420
San Francisco, CA 94105
Phone: (415) 975-4310
Fax: (415) 975-4319

Region 10: AK, ID, OR, WA
U.S. Department of Labor—OSHA
1111 Third Ave., Ste. 715
Seattle, WA 98101–3212
Phone: (206) 553–5930
Fax: (206) 553–6499

Appendix C

Appendix C

Contents

ASSIGNED PROTECTION FACTORS

From NIOSH Respirator Decision Logic				ANSI Z88.2–1992
Respirator Type	**Particulate Hazards**	**Gas/Vapor Hazard**	**Combin. Gas Vapor & Particulate Hazard**	**Any Hazard**
Single-use or quarter mask	5	N/A	N/A	10
APR half-mask except single-use	**10**	**10**	**10**	**10**
APR full facepiece	**10**	**50**	**10**	**10**
SAR halfmask demand	10	10	10	10
SAR full facepiece demand	50	50	50	100
SAR hood or helmet loose fitting continuous	25	25	25	1,000
SAR hood or helmet continuous	25	25	25	1,000
SAR half mask continuous	50	50	50	50
SAR full facepiece continuous	50	50	50	1,000
PAPR hood or helmet loose fitting	**25**	**25**	**25**	**25**
PAPR hood or helmet tight fitting	25	50	N/A	1,000
PAPR half mask	**50**	**50**	**50**	**50**
PAPR full facepiece	50	50	50	1,000
SCBA full facepiece demand	50	50	50	100
SAR half mask pressure demand	1,000	1,000	1,000	50
SAR full facepiece pressure demand	**2,000**	**2,000**	**2,000**	**1,000**
SCBA full facepiece pressure demand	**10,000**	**10,000**	**10,000**	**10,000**
SAR full facepiece pressure demand w/escape bottle or SCBA pressure demand	**10,000**	**10,000**	**10,000**	

PARTIAL LIST OF INCOMPATIBLE CHEMICALS*

Substances in the right-hand column should be stored and handled so they will not come in contact with the substances in the left-hand column.

Acetic acid	Chromic acid, nitric acid, hydroxyl containing compounds, ethylene, perchloric acid, peroxides, and glycol permanganates
Acetone	Concentrated nitric and sulfuric acid mixtures
Acetylene	Chlorine, bromine, copper, silver, fluorine, and mercury
Alkaline and alkaline earth metals	Carbon dioxide, and carbon tetrachloride. Prohibit water, foam, and dry chemicals on fires involving these metals.
Ammonia (anhydrous)	Mercury, chlorine, calcium hypochlorite, iodine, bromide, and hydrogen fluoride
Ammonium nitrate	Acids, metal powders, flammable liquids, chlorine, nitrites, sulfur, and finely divided organics or combustibles
Analine	Nitric acid and hydrogen peroxide
Bromine	Ammonium salts, acetylene, butadiene, butane and other petroleum gases, sodium carbide, turpentine, benzene, and finely divided metals
Calcium carbide	Water (see also acetylene)
Calcium oxide	Water
Chlorates	Ammonium salts, acids, metal powders, sulfur, and finely divided organics or combustibles
Chlorine	Ammonia, acetylene, butadiene, butane and other petroleum gases, hydrogen, sodium carbide, turpentine, benzene, and finely divided metals

*Based on Dangerous Chemicals Code, 1951, Edition, pp. 19-20, Bureau of Fire Prevention, City of Los Angeles, Fire Department, published by Parked and Company, Los Angeles, CA.

Chlorine dioxide	Ammonia, methane, phosphine, and hydrogen sulfur
Chromic acid	Acetic acid, naphthalene, camphor, glycerine, turpentine, alcohol, and other flammable liquids
Copper	Acetylene and hydrogen peroxide
Fluorine	Isolate from everything
Hydrocarbons (benzene, butane, propane, gasoline, turpentine, etc.)	Fluorine, chlorine, bromine, chromic, acid, sodium peroxide
Hydrocyanic acid	Nitric acid and alkalies
Hydrofluoric acid, anhyd. (Hydrogen fluoride)	Ammonia (aqueous or anhydrous)
Hydrogen peroxide	Copper, chromium, iron, most metals or their salts, any flammable liquid, combustible materials, aniline, nitromethane, caustic soda and other strong alkalies
Hydrogen sulfide	Fuming nitric acid and oxidizing gases
Iodine	Acetylene, ammonia (anhydrous or aqueous)
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfides, flammable liquids, flammable gases, and nitritable substances
Nitroparaffins	Inorganic bases
Oxalic acid	Silver and mercury
Oxygen	Oils, grease, and hydrogen, flammable liquids, solids or gases
Oxygen (compressed or liquid)	Oils, grease, hydrogen, flammable liquids, solids or gases

Perchloric acid	Acetic anhydride, bismuth and its alloys, alcohol, paper, wood, grease and oils, any hydrating agents
Peroxides	Combustibles, magnesium, zinc or aluminum powders
Peroxides, organic	Acids (organic or mineral) and avoid friction
Phosphorus (white)	Air, oxygen, nitric acid, nitrates, nitrites, chlorates, perchlorates
Phosphorus oxychloride	Water, alcohol
Phosphorus pentoxide	Water
Picric acid	Metals
Potassium	Carbon tetrachloride, carbon dioxide, water, lower aliphatic alcohols
Potassium chlorate (see also chlorates) combustibles	Sulfuric acid, other acids, sulfur, sulfites, hypophosphites, finely divided organics or
Potassium ferricyanide or	Halogen with ammonia mercuricyanide
Potassium percihlorate	Sulfuric acid, other acids, finely divided (see also chlorates) organics or combustibles
Potassium permanganate	Glycerine, ethylene glycol, benzaldehyde, sulfide acid, alcohols, ether, flammable gases and combustible materials
Propane	see Hydrocarbons
Prussic acid	Acetylene, oxalic acid, tartaric acid, fulminic acid, ammonium compounds, picric acid
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium chlorate	Combustible materials, sulfur, acids

Sodium chlorite	Combustible materials, sulfur, acids
Sodium hypochlorite	Water
Sodium nitrate	Ammonium nitrate and other ammonium salts
Sodium oxide	Water
Sodium peroxide	Any oxidizable substance (such as ethanol, methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerine, ethylene glycol, ethyl acetate, methyl acetate, and furfural)
Sulfur	Chlorates, nitrates, other oxidizing material
Sulfuric acid	Sulfides, nitrates, nitrites, fluorides, bromides, iodides, fulminates, saltpeter, metallic powders, carbides, picrates, chlorates, perchlorates, permanganates, and other combustible materials. Potassium chlorate, potassium perchlorate, potassium permanganate (or such compounds with similar light metals, as sodium, lithium, etc.)
Titanium	Do not use water, carbon tetrachloride foam or dry chemical on titanium fires
Turpentine	(see hydrocarbons)
Water	Alkali metals and oxides, alkali metal hydrides, sulfuric acid, oleum, sulfur trioxide, phosphorus pentachloride, acetyl chloride, phosphorus pentoxide
Zinc powder or dust	Acids, sodium hydroxide, potassium hydroxide, moisture
Zirconium	Prohibit water, carbon tetrachloride foam, and dry chemical on zirconium fires

CONTAINS HAZARDOUS MATERIALS

FOR HELP IN CHEMICAL EMERGENCIES INVOLVING SPILL, LEAK, FIRE OR EXPOSURE, CALL
TOLL FREE 1-800-424-9300 DAY OR NIGHT

STRAIGHT BILL OF LADING
ORIGINAL–NOT NEGOTIABLE

Shipper's No
Carrier's No.
SCAC
Date

(NAME OF CARRIER)

TO: Consignee	**FROM**: Shipper
Street	Street
Destination Zip	Origin Zip
Route	Vehicle #

No. Shipping Units	H M	Kind of Packages, Description of Articles (IF HAZARDOUS MATERIALS—PROPER SHIPPING NAME)	Hazard Class	I.D. Num.	Weight	RATE	LABELS REQUIRED (or exemption)

Remit C.O.D. to: Address: City St ZIP	<u>**C.O.D.**</u> <u>Amt: $</u>	COD FEE: Prepaid Collect
NOTE—Where the rate is dependent on value, shippers are required to state specifically in writing the agreed or declared value of the property. The agreed or declared value of the property is hereby specifically stated by the shipper to be not exceeding $ ____________ per __________	Subject to Section 7 of the conditions, if this shipment is to be delivered to the consignee without recourse on the consignor, the consignor shall sign the following statement: The carrier shall not make delivery of this shipment without payment of freight and all other lawful charges. ______________________________ Signature of consignor	FREIGHT CHARGES Prepaid Collect

RECEIVED, subject to the classifications and lawfully filed tariffs in effect on the date of issue of this Bill of Lading, the property described above in apparent good order, except as noted (contents and condition of contents of packages unknown), marked, consigned, and destined as indicated above which said carrier (the word carrier being understood throughout this contract as meaning any person or corporation in possession of the property under the contract) agrees to carry to its usual place of delivery at said destination, if on its route, otherwise to deliver to another carrier on the route to said destination. It is mutually agreed as to each carrier of all or any of said property over all or any portion of said route to destination and as to each party at any time interested in all or any said property, that every service to be performed hereunder shall be subject to all the bill of lading terms and conditions in the governing classification on the date of shipment. Shipper hereby certifies that he is familiar with all the bill of lading terms and conditions in the governing classification and the said terms and conditions are hereby agreed to by the shipper and accepted for himself and his assigns.

This is to certify that the above-named materials are properly classified, described, packaged, marked and labeled and are in proper condition for transportation according to the applicable regulations of the Department of Transportation.	PLACARDS R E Q U I R E D yes ___ no ___ PLACARDS S U P P L I E D yes ___ no ___
SHIPPER PER DATE	CARRIER PER DATE

EMERGENCY RESPONSE
TELEPHONE NUMBER:
(______) _________________

Manned 24 hrs/day by a person with knowledge of the hazards of the material and emergency response information or who has access to a person with that knowledge.

Uniform Hazardous Waste Manifest Form

1. Generator's US EPA ID No.	Manifest Document No.	2. Page 1	*Italicized information is not required by Federal law*
O H D 0 4 1 0 6 4 7 6 7	0 0 0 0 6 5	of 6	

3. Generator's Name and Mailing Address Waste Source, 13 Dead-end Road, Anywhere USA	*A. State Manifest Document Number*
4. Generator's Phone (999) 777-3333	*B. State Generator's ID*

5. Transporter 1 Company Name Take-away	6. US EPA ID Number O H D 9 8 2 6 0 3 9 4 6	*C. Transporter's ID* *D. Transporter's Phone 513/874-1144*
7. Transporter 2 Company Name	8. US EPA ID Number	*E. State Transporter's ID* *F. Transporter's Phone*
9. Designated Facility and Site Address Wee Stor-it, Roads End, Nimby OH	10. US EPA ID Number O H D 0 8 3 3 7 7 0 1 0	*G. State Facility's ID* *H. Facility's Phone 513/541-1823*

11. US DOT Description (Including Proper Shipping Name, Hazard Class and I D Number)	12. Container No.	12. Container Type	13. Total Quality	14. Unit Wt/ Vol	*I. Waste No*
a."RQ" Waste Flammable Liquid NOS Flammable Liquid UN1993 (D001, F001, F002) (Lab Chemicals)	0 0 1	D M	0 0 0 2 0	G	D001,F001 F002
b."RQ" Waste Flammable Liquid NOS Flammable Liquid UN1993 (D001, D007, F005, F003) (Lab Chem.)	0 0 1	D M	0 0 0 1 1	G	D001,D007 F003,F005
c."RQ" Waste Flammable Liquid NOS Flammable Liquid UN1993 (D001, F003, F005) (Lab Chemicals)	0 0 2	D M	0 0 0 4 0	G	D001,F003 F005
d."RQ" Waste Flammable Liquid NOS Flammable Liquid UN1993 (D001, F002, F003, F005) (Lab Chem.)	0 0 4	D M	0 0 0 8 0	G	D001,F002 F003, F005

G E N E R A T O R

J. Additional Descriptions for Materials Listed above Lab Chemicals, Profile # 55708 a) HCT# 91-18249 (1 X 55) c) HCT # 91-18250,18254 (2 X 55) b) HCT# 91-18264 (1 X 55) d) HCT# 91-18252-53, 91-18247-48 (4 X 55)	*K. Handling Codes for Wastes Listed Above*

15. Special Handling Instructions and Additional Information: Emergency Contact: (513)888-4422

16. GENERATOR'S CERTIFICATION: I Hereby declare that the contents of this consignment are fully and accurately described above by proper shipping name and are classified, packed, marked, and labeled, and are in all respects in proper condition for transport by highway according to applicable international and national government regulation and according to the requirements of the State Department of Natural Resources. If I am a large quantity generator, I also certify that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable and I have selected the practicable method of treatment. storage, or disposal currently available to me which minimizes the present and future threat to human health and the environment; OR, if I am a small quantity generator, I have made a good faith effort to minimize my waste generation and select the best waste management method that is available to me and that I can afford.

Printed/Typed Name & Position Title	Signature	Date
I. Made-it — Supervisor	I. Made-it	06/18/91

Uniform Hazardous Waste Manifest Form (Cont.)

<table>
<tr><td rowspan="4">T
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A
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T
E
R</td><td colspan="3">17. TRANSPORTER 1 Acknowledgment of Receipt of Materials</td></tr>
<tr><td>Printed/Typed Name & Position Title

Take Away —Receiver</td><td>Signature

Take Away</td><td>Month Day Year
06/18/91</td></tr>
<tr><td colspan="3">18. TRANSPORTER 2 Acknowledgment of Receipt of Materials</td></tr>
<tr><td>Printed/Typed Name & Position Title

Got It — Driver</td><td>Signature

Got It</td><td>Month Day Year
06/18/91</td></tr>
<tr><td rowspan="3">F
A
C
I
L
I
T
Y</td><td colspan="3">19. Discrepancy Indication Space</td></tr>
<tr><td colspan="3">20. Facility Owner or Operator: Certification for receipt of hazardous materials covered by this manifest
except as noted on Item 19.</td></tr>
<tr><td>Printed/Typed Name & Position Title

I Took-it — President</td><td>Signature

I. Took-it</td><td>Month Day Year
06/18/91</td></tr>
</table>

NIOSH Pocket Guide Directions

The NIOSH Pocket Guide to Chemical Hazards has a lot of useful information in one place. But it can be hard to use. Here are step-by-step directions:

Step 1: Find the chemical

Chemicals are listed alphabetically, using the first letter in the chemical's name:

For example:
Nitromethane
1-Nitronaphthalene
1-Nitropropane
2-Nitropropane

Be sure to match the exact name: propenal and propenol may look similar but they are very different chemicals. If you cannot find the exact name, look in the index that starts on page 389.
This index shows you that propenal is on p. 6–also called acrolein. Propenol is on p. 10–also called allyl alcohol.

Exceptions–these are not used for alphabetical order:
a small m-, n-, o- or p-; bis- , sec- or tert-; N, N-, or β

For example:
2-Butoxyethanol
n-Butyl acetate
sec-Butyl acetate
tert-Butyl acetate
Butyl acrylate
n-Butyl alcohol

Step 2: Legal Limits and Recommended Limits

Column 3: Exposurelimits (TWA unless noted otherwise)

If there are NIOSH recommended limits, they will come first, then the OSHA legal limits are listed.

For acetone, the OSHA legal limit is:
1000 ppm (parts per million)

Step 3: Immediately Dangerous to Life and Health Levels

Column 4: IDLH

If there is an Immediately Dangerous to Life and Health level, it will be listed her.For acetone, the IDLH level is:
2500 ppm
[10% LEL]" This means that this limit is based on a fire danger

Step 4: Physical Description

Column 5: Physical description

Remember: many chemicals will be at a very high, dangerous level before you can smell them. For acetone, the physical description is: Colorless liquid with a fragrant mint-like odor.

Step 5: Routes of Entry

Column 12: Route [of entry]

This column tells you all the ways that a chemical might get into your body:
Inh [Inhalation = breathing in]
Ing [Ingestion = accidentally swallowing
Abs [Absorption = Soaking through your skin and getting into your blood and into your organs]
Con [Contact = Damaging your skin on the outside]

For acetone, the routes of entry are:
Inh, Ing, Con

Step 6: Target Organs

Column 15: Target organs

These are the body systems that this chemical is known to damage.This column contains many abbreviations, which are spelled out in Table 5 on page xxxiii at the beginning of the Pocket Guide.

For acetone, the target organs are:
Eyes, skin, resp sys [respiratory system = lungs], CNS [Central Nervous System = brain and spinal cord]

Survey Work Before Cleanup Begins
OSHA's 6 Steps for Site Characterization

Step	What does OSHA call it?	What question is answered?	How is it done?
Step 1.	Preliminary evaluation	What chemicals might be there, given the history of the site? What dangers could be there?	Interview people who worked there. Look at office & government records, photographs, plans. Study the land, weather, and water around the site.
Step 2.	Hazard identification	What chemicals are actually there? Are there life-threatening dangers now (chemicals could explode now, poison gases could be in air now)	Test inside drums, tanks. Look for dead animals or plants, look for pits where gases could collect. Full-body chemical suit & supplied air (called Level B) needed.
Step 3.	Risk identification.	Exactly what are the dangers based on the chemical measurements.	Figure out what the dangers to workers are based in the information collected above. For ex., how much explosive gas is in the air? Could it explode easily?
Step 4.	Site control plan, (part of the safety and health plan)	How will the work be done?	Write a plan for doing the work using all of the information collected. Includes a map showing land, water, and work areas; work teams; communication; Standard Operating Procedures; nearby hospital.
Step 5.	Safety & health plan (includes site control plan above).	How will work be done safely?	Write a plan for testing the air; protective gear; medical exams; special work methods; decontamination. Includes site control plan above.
Step 6.	Notification	What dangers do workers need to know about?	Notify workers in writing or in person.

Sample Survey of a HazWaste Site
The 6 Steps Put into Practice: Site Characterization

Note: This is an example of OSHA's 6 steps for an imaginary pesticide factory called the Sur-Gone plant. The factory closed down two years ago and the building will be torn down to make way for a new hospital. Before it can be torn down, the hazardous waste must be removed.

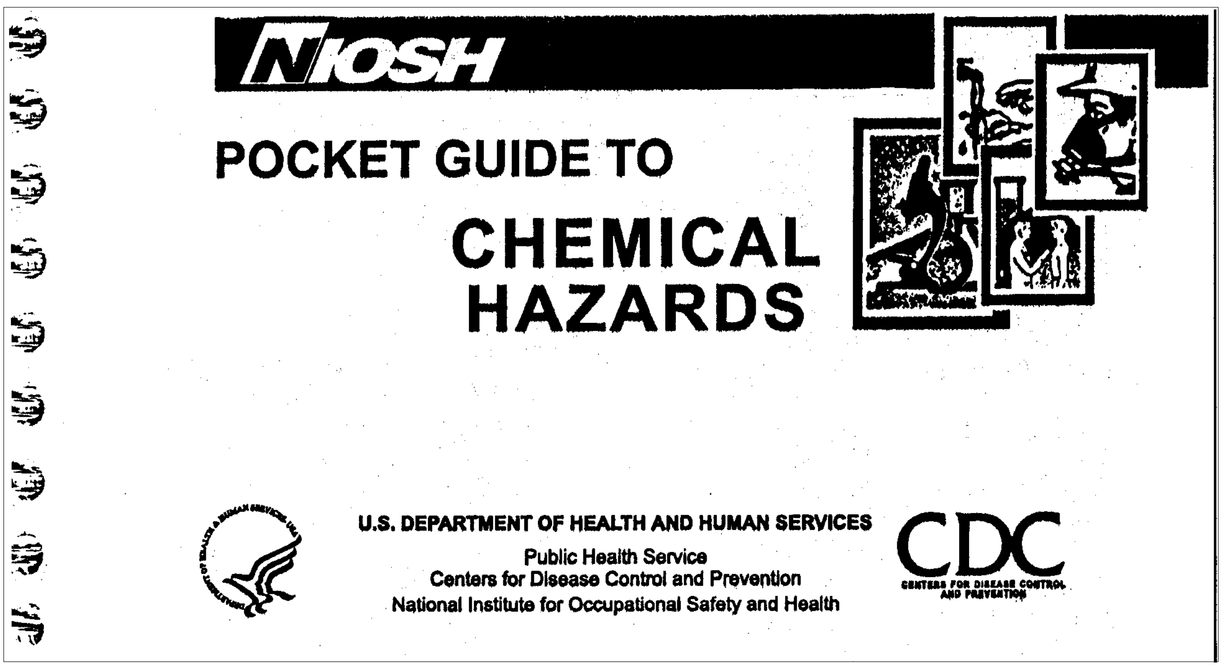
Step	**What does OSHA call it?**	**What question is answered?**	**How is it done?**
Step 1.	**Preliminary evaluation**	**What chemicals <u>might</u> be in the Sur-Gone plant given the history of the site? What dangers could be there?**	**Interview the plant manager and several workers who worked at the Sur-Gone plant. Look at the office files for chemicals received and shipped. Look at government records for land purchase, building permits, waste permits. Surveyors and local extension agents provide information about the land (flat), weather (rainy and windy spring), and water (no ponds or creeks, water table 20 feet below land) around the site.**
Step 2.	**Hazard identification**	**What chemicals are actually in the Sur-Gone plant? Are there life-threatening dangers <u>now</u> (chemicals could explode now, poison gases could be in air now)**	**Technicians wearing full-body chemical suits & air tanks (called Level B) go inside the plant. They look for drums, tanks, asbestos, and lead paint. They open up drums (all on the 2nd floor) and test inside the top of the drums using "sniffers" to test for flammable chemicals and some poisons. They dip in jars and take samples of some chemicals for the lab and look at labels on the drums to try to figure out what might be inside. They take some small pieces of paint and insulation for the lab. They also look for tanks where gases could collect and suffocate cleanup workers. There is one empty tank outside, and the survey crew tests the air and also wipes off a spot on the inside of the tank to send to the lab.**

Step 3.	**Risk identification.**	**Exactly what are the dangers to cleanup workers at the Sur-Gone plant, based on the samples and tests they took from inside the plant?**	**Tests show two pesticides--DDT and lindane--asbestos insulation and no lead paint. Dangers are from breathing in all three chemicals (all dusts), and getting pesticides on the skin. All 3 are dangerous if swallowed, but workers will always wear masks and shower at the end of the day, so they will be protected from this danger. Could damage brain and nerves, eyes, blood, kidneys, liver, and lungs, could cause cancer years after cleanup. The chemicals are not highly flammable and will not react with each other. One large storage tank outside is clean, but rust has used up the oxygen inside, so ventilation will be required if entry is needed.**
Step 4.	**Site control plan, (part of the safety and health plan)**	**How will work be done at the Sur-Gone plant?**	**The cleanup contractor's safety officer writes a 40-page plan for doing the work at Sur-Gone using all of the information collected. A HazWaste crew will clean up the 2 pesticides. A special asbestos crew will remove the asbestos after the HazWaste is cleaned up. The HazWaste plan includes a map showing the property, which slopes down in back; the work areas on the 2nd floor (drums and asbestos); work teams; communication; SOPs; and how to contact Memorial Hospital down the road.**
Step 5.	**Safety & health plan (includes site control plan above).**	**How will the work be done safely at Sur-Gone?**	**The safety officer writes a detailed plan for testing the air (the 2 pesticides each have a different test); protective gear (disposable plastic-coated suits and supplied air); medical exams; special work methods (including how to keep dust out of the air); showering up (decon-tamination). This plan includes the site control plan above.**

Step 6.	**Notification**	**What dangers at Sur-Gone do work-ers need to know about?**	**Before work begins the crew gets a briefing on the dangers of Lindane and DDT and how the plastic suits and supplied air will protect them. They also learn about everything in the safety and health plan and the site safety plan for this job (like where they will shower off, using water to keep dust down, testing for the pesticides in the air, working outside the storage tank, and so on).**

Understanding the NIOSH
Pocket Guide to Chemical Hazards

The June 1997 440 page *NIOSH Pocket Guide* containing 667 chemicals, forty pages of introduction, Appendices A-G, and two indices has a green cover that looks like ...



Chemicals are listed alphabetically, four to a two-page flat. On the next page are the two *Pocket Guide* pages containing the chemical **Toluene**.

While this learning guide stands alone, it works best when used with your copy of the *NIOSH Pocket Guide*.

<table>
<tr><th>Chemical name, structure/formula, CAS and RTECS Nos., and DOT ID and guide Nos.</th><th>Synonyms, trade names, and conversion factors</th><th>Exposure limits (TWA unless noted otherwise)</th><th>IDLH</th><th>Physical description</th><th colspan="2">Chemical and physical properties</th><th>Incompatibilities and reactivities</th><th>Measurement method (See Table 1)</th></tr>
<tr><th></th><th></th><th></th><th></th><th></th><th>MW, BP, SOL
Fl.P, IP, Sp, Gr, flammability</th><th>VP, FRZ
UEL, LEL</th><th></th><th></th></tr>
<tr><td>Titanium dioxide
TiO_2
13463-67-7
XR2275000</td><td>Rutile,
Titanium oxide,
Titanium peroxide</td><td>NIOSH
Ca
See Appendix A
OSHA†
15 mg/m³</td><td>Ca
[5000 mg/m³]</td><td>White, odorless powder.</td><td>MW: 79.9
BP: 4532-5432°F
Sol: Insoluble
Fl.P: NA
IP: NA
Sp.Gr: 4.26
Noncombustible Solid</td><td>VP: 0 mm (approx)
MLT: 3326-3362°F
UEL: NA
LEL: NA</td><td>None reported</td><td>Filter;
Acid;
FAAS;
II(3)
[#S385]</td></tr>
<tr><td>o-Tolidine
$C_{14}H_{16}N_2$
119-93-7
DD1225000</td><td>4,4'-Diamino-3,3'-dimethyl-biphenyl;
Diaminoditolyl;
3,3'-Dimethylbenzidine;
3,3'-Dimethyl-4,4'-diphenyl-diamine;
3,3'-Tolidine</td><td>NIOSH
Ca
See Appendix A
See Appendix C
C 0.02 mg/m³
[60-min]
[skin]
OSHA
See Appendix C</td><td>Ca
[N.D.]</td><td>White to reddish crystals or powder. [Note: Darkens on exposure to air. Often used in paste or wet cake form. Used as a basis for many dyes.]</td><td>MW: 212.3
BP: 572°F
Sol: 0.1%
Fl.P: ?
IP: ?
Sp.Gr: ?
Combustible Solid</td><td>VP: ?
MLT: 264°F
UEL: ?
LEL: ?</td><td>Strong oxidizers</td><td>Filter;
Water;
HPLC/UVD;
IV
[#5013, Dyes]</td></tr>
<tr><td>Toluene
$C_6H_5CH_3$
108-88-3
XS5250000
1294 130</td><td>Methyl benzene,
Methyl benzol,
Phenyl methane,
Toluol
1 ppm = 3.77 mg/m³</td><td>NIOSH
100 ppm
(375 mg/m³)
ST 150 ppm
(560 mg/m³)
OSHA†
200 ppm
C 300 ppm
500 ppm (10-min max peak)</td><td>500 ppm</td><td>Colorless liquid with a sweet, pungent, benzene-like odor.</td><td>MW: 92.1
BP: 232°F
Sol(74°F): 0.07%
Fl.P: 40°F
IP: 8.82 eV
Sp.Gr: 0.87
Class IB Flammable Liquid</td><td>VP: 21 mm
FRZ: -139°F
UEL: 7.1%
LEL: 1.1%</td><td>Strong oxidizers</td><td>Char;
CS_2;
GC/FID;
IV
[#1500, Hydro-carbons]
[Also #4000, #1501]</td></tr>
<tr><td>Toluenediamine
$CH_3C_6H_3(NH_2)_2$
25376-45-8
95-80-7 (2,4-TDA)
XS9445000
XS9625000 (2,4-TDA)
1709 181</td><td>Diaminotoluene,
Methylphenylene diamine,
TDA,
Tolylenediamine</td><td>NIOSH
Ca (all isomers)
See Appendix A
OSHA
none</td><td>Ca
[N.D.]</td><td>Colorless to brown, needle-shaped crystals or powder. [Note: Tends to darken on storage & exposure to air. Properties given are for 2,4-TDA.]</td><td>MW: 122.2
BP: 558°F
Sol: Soluble
Fl.P: 300°F
IP: ?
Sp.Gr: 1.05 (Liquid at 212°F)
Combustible Solid</td><td>VP(224°F): 1mm
MLT: 210°F
UEL: ?
LEL: ?</td><td>None reported</td><td>Imp;
Reagent;
HPLC/UVD;
IV
[#5516]</td></tr>
</table>

Pages 310-311

<table>
<tr><th rowspan="2">Personal protection and sanitation (See Table 3)</th><th rowspan="2">Recommendations for respirator selection — maximum concentration for use (MUC) (See Table 4)</th><th colspan="5">Health hazards</th></tr>
<tr><th>Route</th><th>Symptoms (See Table 5)</th><th colspan="2">First aid (See Table 6)</th><th>Target organs (See Table 5)</th></tr>
<tr><td>Skin: N.R.
Eyes: N.R.
Wash skin: N.R.
Remove: N.R.
Change: Daily
[Titanium dioxide]</td><td>NIOSH
¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA
Escape: HiEF/SCBAE</td><td>Inh</td><td>Lung fib; [carc]</td><td>Breath:</td><td>Resp support</td><td>Resp sys
[in animals: lung tumors]</td></tr>
<tr><td>Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash, Quick drench
[o-Tolidine]</td><td>NIOSH
¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA
Escape: GMFOVHiE/SCBAE</td><td>Inh
Abs
Ing
Con</td><td>Irrit eyes, nose; in animals: liver, kidney damage; [carc]</td><td>Eye:
Skin:
Breath:
Swallow:</td><td>Irr immed
Soap flush immed
Resp support
Medical attention immed</td><td>Eyes, resp sys, liver, kidneys
[in animals: liver, bladder & mammary gland tumors]</td></tr>
<tr><td>Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet (flamm)
Change: N.R.
[Toluene]</td><td>NIOSH
500 ppm: CCROV*/PAPROV*/GMFOV/SA*/SCBAF
§: SCBAF:PD,PP/SAF:PD,PP:ASCBA
Escape: GMFOV/SCBAE</td><td>Inh
Abs
Ing
Con</td><td>Irrit eyes, nose; ftg, weak, conf, euph, dizz, head; dilated pupils, lac; ner, musc ftg, insom; pares; derm; liver, kidney damage</td><td>Eye:
Skin:
Breath:
Swallow:</td><td>Irr immed
Soap wash prompt
Resp support
Medical attention immed</td><td>Eyes, skin, resp sys, CNS, liver, kidneys</td></tr>
<tr><td>Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam/Daily
Remove: When wet or contam
Change: Daily
Provide: Eyewash, Quick drench
[Toluenediamine]</td><td>NIOSH
¥: SCBAF:PD,PP/SAF:PD,PP:ASCBA
Escape: GMFOV/SCBAE</td><td>Inh
Abs
Ing
Con</td><td>Irrit eyes, skin, nose, throat; derm; ataxia, tacar, nau, vomit, convuls, resp depres; methemo, cyan, head, ftg, dizz, bluish skin; liver inj; [carc]</td><td>Eye:
Skin:
Breath:
Swallow:</td><td>Irr immed
Water flush immed
Resp support
Medical attention immed</td><td>Eyes, skin, resp sys, blood, CVS, liver, CNS
[in animals: liver, skin & mammary gland tumors]</td></tr>
</table>

Toluene
$C_6H_5CH_3$
108-88-3
XS5250000
1294 130

The each two-page flat of four chemicals has fourteen columns, starting on the far left. The first column is titled: **Chemical name, structural formula, CAS and RTECS Nos., and DOT ID and guide Nos**. Toluene is the third chemical from the top, or second chemical from the bottom, beginning on page 310. The first column has four lines of information about toluene (see box at left).

If we focus on the CAS number **108-88-3**, we can utilize the CAS Number Index at the back of the *Pocket Guide*. If you come across a barrel at your work site without a label and marked only with a CAS number, you can then check the number using your CAS Number Index. On page 378 of the *Pocket Guide*, you will find the column reproduced to the right. You see from the information in the column that you are to turn to page 310 of the *Pocket Guide* to find the chemical with the CAS number 108-88-3, toluene.

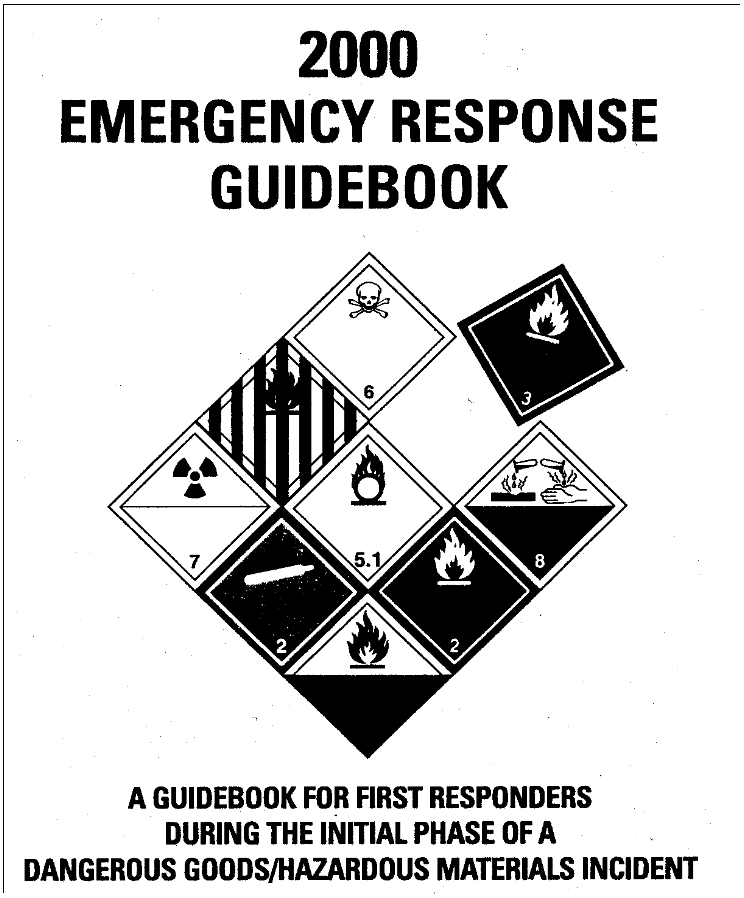
108-05-4:328
108-10-1:164
108-11-2:212
108-18-9:110
108-20-3:182
108-21-4:180
108-24-7: 2
108-31-6:188
108-38-3:336
108-39-4: 78
108-44-1:312
108-46-3:272
108-67-8:320
108-83-8:108
108-84-9:164
108-87-2:204
108-88-3:310
108-90-7: 62
108-91-8: 84
108-93-0: 84

Next, look again to the first column on page 310. Find the DOT ID and Guide Numbers **1294 130** at the bottom of this column, under Toluene. You can then find your copy of the DOT *Emergency Response Guidebook 2000* and turn to the orange section and find Guide Number 130, which is on pages 224-225. Here you can learn more about toluene. This DOT ID number would also be useful, for example, if a tanker truck at your work site started leaking. Not having a shipping manifest close by, you notice the numbers in the middle of the diamond-shaped placards on the truck. They read: 1294. Grabbing your handy *Pocket Guide*, you turn to the DOT ID Number Index at the back of the book and find 1294 in this column on page 385(see column to the left on this page). You are sent to

1249:244
1255:246
1256:220
1259:222
1261:230
1262:236
1265:244
1268:286
1271:332
1274:268
1276:266
1279:268
1280:270
1282:272
1292:142
1294:310

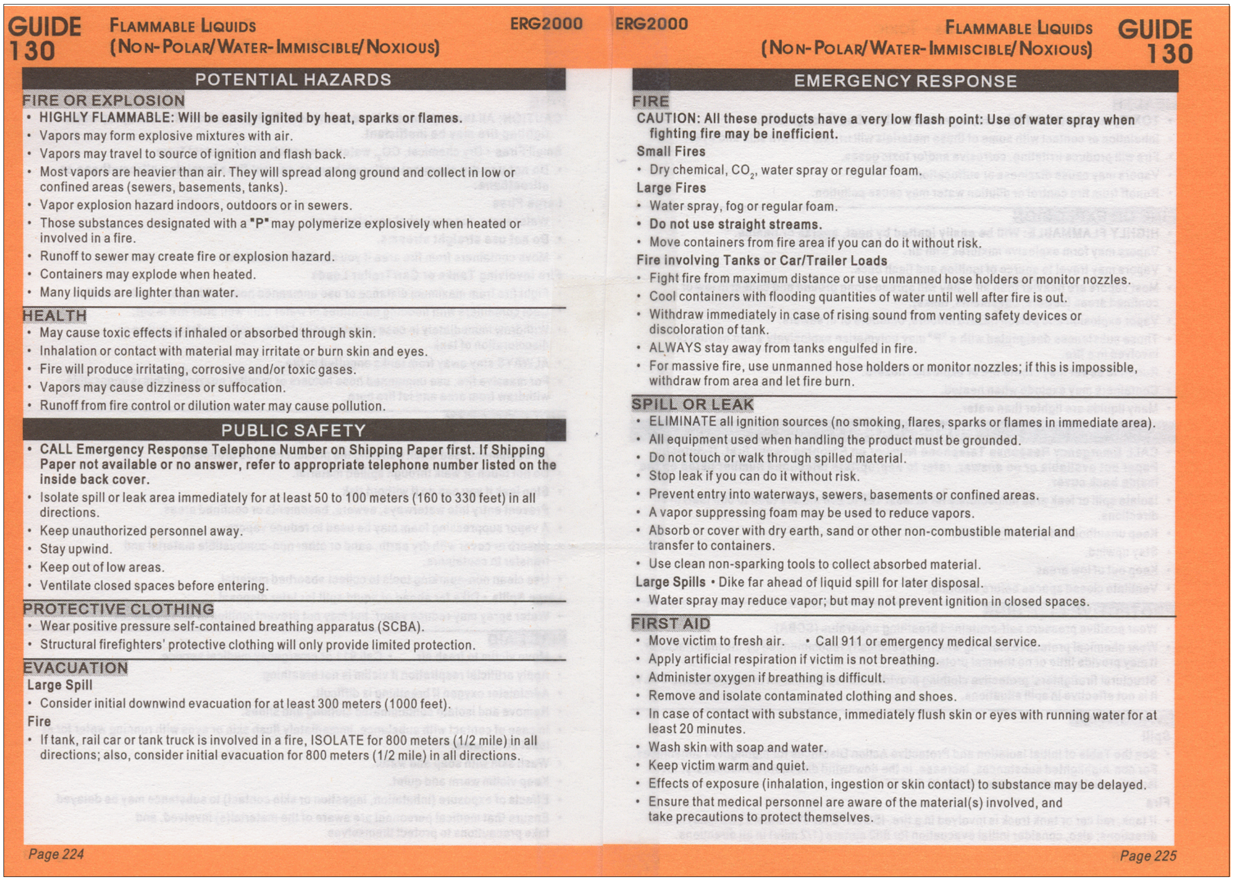
page 310 were you locate a chemical with the DOT ID of 1294. You discover that the DOT Guide Number for 1294 is 130 and the chemical is toluene.

The mustard-colored cover to the *ERG 2000* looks like this:



On the top half of the next page are two pages for Guide Number 130 in the *ERG 2000.*

Moving to Column Two on page 310, one finds this heading: **Synonyms, trade names, and conversion factors.** Looking down to the third row at toluene, you determine that there are four other names for toluene, at least for now: **Methyl benzene, Methyl benzol, Phenyl methane, Toluol.** These names are useful when a label or the only information we can readily get is a synonym or trade name. Imagine a five gallon metal can with commercial label on it with the name Phenyl methane. What does this mean? To find out, look to the back of the *Pocket Guide* for the Synonym and Trade Name Index. On page 248 there


GUIDE 130 FLAMMABLE LIQUIDS (NON-POLAR/WATER-IMMISCIBLE/NOXIOUS) ERG2000

POTENTIAL HAZARDS

FIRE OR EXPLOSION
- **HIGHLY FLAMMABLE: Will be easily ignited by heat, sparks or flames.**
- Vapors may form explosive mixtures with air.
- Vapors may travel to source of ignition and flash back.
- Most vapors are heavier than air. They will spread along ground and collect in low or confined areas (sewers, basements, tanks).
- Vapor explosion hazard indoors, outdoors or in sewers.
- Those substances designated with a "P" may polymerize explosively when heated or involved in a fire.
- Runoff to sewer may create fire or explosion hazard.
- Containers may explode when heated.
- Many liquids are lighter than water.

HEALTH
- May cause toxic effects if inhaled or absorbed through skin.
- Inhalation or contact with material may irritate or burn skin and eyes.
- Fire will produce irritating, corrosive and/or toxic gases.
- Vapors may cause dizziness or suffocation.
- Runoff from fire control or dilution water may cause pollution.

PUBLIC SAFETY
- **CALL Emergency Response Telephone Number on Shipping Paper first. If Shipping Paper not available or no answer, refer to appropriate telephone number listed on the inside back cover.**
- Isolate spill or leak area immediately for at least 50 to 100 meters (160 to 330 feet) in all directions.
- Keep unauthorized personnel away.
- Stay upwind.
- Keep out of low areas.
- Ventilate closed spaces before entering.

PROTECTIVE CLOTHING
- Wear positive pressure self-contained breathing apparatus (SCBA).
- Structural firefighters' protective clothing will only provide limited protection.

EVACUATION

Large Spill
- Consider initial downwind evacuation for at least 300 meters (1000 feet).

Fire
- If tank, rail car or tank truck is involved in a fire, ISOLATE for 800 meters (1/2 mile) in all directions; also, consider initial evacuation for 800 meters (1/2 mile) in all directions.

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ERG2000 FLAMMABLE LIQUIDS (NON-POLAR/WATER-IMMISCIBLE/NOXIOUS) GUIDE 130

EMERGENCY RESPONSE

FIRE

CAUTION: All these products have a very low flash point: Use of water spray when fighting fire may be inefficient.

Small Fires
- Dry chemical, CO_2, water spray or regular foam.

Large Fires
- Water spray, fog or regular foam.
- **Do not use straight streams.**
- Move containers from fire area if you can do it without risk.

Fire involving Tanks or Car/Trailer Loads
- Fight fire from maximum distance or use unmanned hose holders or monitor nozzles.
- Cool containers with flooding quantities of water until well after fire is out.
- Withdraw immediately in case of rising sound from venting safety devices or discoloration of tank.
- ALWAYS stay away from tanks engulfed in fire.
- For massive fire, use unmanned hose holders or monitor nozzles; if this is impossible, withdraw from area and let fire burn.

SPILL OR LEAK
- ELIMINATE all ignition sources (no smoking, flares, sparks or flames in immediate area).
- All equipment used when handling the product must be grounded.
- Do not touch or walk through spilled material.
- Stop leak if you can do it without risk.
- Prevent entry into waterways, sewers, basements or confined areas.
- A vapor suppressing foam may be used to reduce vapors.
- Absorb or cover with dry earth, sand or other non-combustible material and transfer to containers.
- Use clean non-sparking tools to collect absorbed material.

Large Spills • Dike far ahead of liquid spill for later disposal.
- Water spray may reduce vapor; but may not prevent ignition in closed spaces.

FIRST AID
- Move victim to fresh air. • Call 911 or emergency medical service.
- Apply artificial respiration if victim is not breathing.
- Administer oxygen if breathing is difficult.
- Remove and isolate contaminated clothing and shoes.
- In case of contact with substance, immediately flush skin or eyes with running water for at least 20 minutes.
- Wash skin with soap and water.
- Keep victim warm and quiet.
- Effects of exposure (inhalation, ingestion or skin contact) to substance may be delayed.
- Ensure that medical personnel are aware of the material(s) involved, and take precautions to protect themselves.

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are two columns. The fifth chemical from the top in the right-hand column is **Phenyl methane, 310.** That is right. On page 310 of the *Pocket Guide* there is a chemical with the synonym of phenyl methane – toluene. Finally, at the bottom of the column the conversion formula from vapors (ppm) to particulates (mg/m^3) is given as 1 ppm = 3.77 mg/m^3.

The third column from the left on page 310 is titled: **Exposure limits (TWA unless noted otherwise)**. The *Pocket Guide* provides both the NIOSH REL (Recommended Exposure Limits) and the OSHA PEL (Permissible Exposure Limit) if available. Both limits are expressed in time-weighted averages (TWA). Short-term Exposure Limits (STEL) and Ceiling Limits (C) may also be given. Explanations for these terms are on pages x-xi of the "Introduction." Looking at this column, the reader finds that OSHA-enforceable PEL for toluene is 200 ppm.

The fourth column is labeled **IDLH**. If a chemical has a concentration which has been determined to be **Immediately Dangerous to Life or Health**, the concentration is listed in this column. Toluene has an IDLH of 500 ppm. NIOSH defines an IDLH condition as one "... that poses a threat of exposure to airborne contaminants when the exposure is likely to cause death or immediate or delayed permanent adverse health effects or prevent escape from such an environment." More information on IDLH can be found on pages xi-xiii of the "Introduction."

The fifth column from the left on page 310 is **Physical description**. Toluene is described as being a **colorless liquid with a sweet, pungent, benzene-like odor**.

MW: 92.1	VP : 21mm
BP: 232ºF	FRZ: -139ºF
Sol (74ºF):	UEL: 7.1%
0.07%	LEL: 1.1%
Fl.P: 40ºF	
IP: 8.82 eV	
Sp. Gr. 0.87	
Class IB Flammable	

Chemical and physical properties is the next column and it is in turn divided into two columns. If the chemical has an RgasD value, it would be listed near the bottom of the column. Pages xiii-xiv of the *Pocket Guide* list the abbreviations and what they represent. See the next page.

One can readily determine from this column that toluene is a highly flammable liquid with a 6% explosive range which as a liquid just does float on water. It has a high vapor pressure and a heavier-than-air vapor density.

With two columns left on page 310, the only one to be discussed here is the **Incompatibilities and reactivities column**. Toluene is incompatible with strong oxidizers and will react.

The ninth column from the left or the first column on page 311 is **Personal protection and sanitation (See Table 3)**. Table 3 is two pages starting with xxiii. This column is straightforward and easy to understand.

The second column on page 311 keys directly to the Exposure and IDLH columns on page 130. Column Ten is **Recommendations for respirator selection – maximum concentration for use (MUC), (See Table 4)**. See the box below.

NIOSH
500 ppm: CCROV*/PAPR*/GMOV/SA*/SCBAF
§:SCBAF:PD,PP/SAF:PD, ASCBA. Escape: GMFOV/SCBAE

Looking at Table 3 (beginning on page xxv), one can find the the numerous symbols and respirator abbreviations listed in Column Ten. For example:

GMFOV (APF=50) .... any air-purifying full facepiece respirator (gas mask) with a chin-style, front-or back-mounted organic vapor canister.

SCBAE .... Any appropriate escape-type, self-contained breathing apparatus.

SCBAF: PD,PP (APF=10,000) ...
Any self-contained breathing apparatus that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode.

SAF:PD,PP:ASCBA ... Any supplied-air respirator that has a full facepiece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained breathing apparatus operated in pressure-demand or other positive-pressure mode.

Chemical and Physical Properties

The following abbreviations are used for the chemical and physical properties given for each substance. "NA" indicates that a property is not applicable, and a question mark (?) indicates that it is unknown.

MW	Molecular weight
BP	Boiling point at 1 atmosphere, °F
Sol	Solubility in water at 68°F*, % by weight (i.e., g/100 ml)
Fl.P	Flash point (i.e., the temperature at which the liquid phase gives off enough vapor to flash when exposed to an external ignition source), closed cup (unless annotated "(oc)" for open cup),°F
IP**	Ionization potential, eV (electron volts)
VP	Vapor pressure at 68°F*, mm Hg; "approx" indicates approximately
MLT	Melting point for solids, °F
FRZ	Freezing point for liquids and gases, °F
UEL	Upper explosive (flammable) limit in air, % by volume (at room temperature*)
LEL	Lower explosive (flammable) limit in air, % by volume (at room temperature*)
MEC	Minimum explosive concentration, g/m^3 (when available)
Sp.Gr	Specific gravity at 68°F* referenced to water at 39.2°F(4°C)
RGasD	Relative density of gases referenced to air = 1 (indicates how many times a gas is heavier than air at the same temperature)

When possible, the flammability/combustibility of a substance was determined and listed after the specific gravity. The following OSHA criteria (29 CFR 1910.106) were used to classify flammable or combustible liquids:

Class IA flammable liquid	Fl.P. below 73°F and BP below 100°F.
Class IB flammable liquid	Fl.P. below 73°F and BP at or above 100°F.
Class IC flammable liquid	Fl.P. at or above 73°F and below 100°F.
Class II combustible liquid	Fl.P. at or above 100°F and below 140°F.
Class IIIA combustible liquid	Fl.P. at or above 140°F and below 200°F.
Class IIIB combustible liquid	Fl.P. at or above 200°F.

*If noted after a specific entry, these properties may be reported at other temperatures.
**Ionization potentials are given as a guideline for the selection of photoionization detector lamps used in some direct-reading instruments.

Route of Health Hazard

This column lists the toxicologically important routes of entry for each substance and whether contact with the skin or eyes is potentially hazardous, abbreviated as follows:

Inh	Inhalation
Abs	Skin absorption
Ing	Ingestion
Con	Skin and/or eye contact
(liq)	Liquid
(sol)	Solid
(soln)	Solution

The remaining four columns fall under the heading of **Health hazards**. The first health hazard column is **Route**, for Route(s) of Entry. Toluene may enter the body any of four ways: **Inh**; **Abs**; **Ing**; and **Con**. Page xvii of the "Introduction" reproduced to the left provides us with the *Pocket Guide's* route of entry meanings.

The second **Health hazards** column is **Symptoms (See Table 5)**. Symptoms listed for toluene are **Irrit eyes, nose; ftg, weak, conf, euph, dizz, head;**

Abbreviation	Symptom/organ	Abbreviation	Symptom/organ
FEV	Forced expiratory volume	jaun	Jaundice
fib	Fibrosis	kera	Keratitis (inflammation of the cornea)
fibri	Fibrillation	lac	Lacrimation (discharge of tears)
ftg	Fatigue	lar	Laryngeal
func	Function	lass	Lassitude (weakness, exhaustion)
GI	Gastrointestinal	leth	Lethargy (drowsiness or indifference)
gidd	Giddiness	leucyt	Leukocytosis (increased blood leukocytes)
halu	Hallucinations		
head	Headache	leupen	Leukopenia (reduced blood leukocytes)
hema	Hematuria (blood in the urine)	li-head	Lightheadedness
hemato	Hematopoietic	liq	Liquid
hemog	Hemoglobinuria	local	Localized
hemorr	Hemorrhage	low-wgt	Weight loss
hyperpig	Hyperpigmentation	mal	Malaise (vague feeling of discomfort)
hypox	Hypoxemia (reduced oxygen in the blood)	malnut	Malnutrition
inco	Incoordination	methemo	Methemoglobinemia
incr	Increase(d)	monocy	Monocytosis (increased blood monocytes)
inebri	Inebriation		
inflamm	Inflammation	molt	Molten
inj	Injury	muc memb	Mucous membrane
insom	Insomnia	musc	Muscle
irreg	Irregular/Irregularities	narco	Narcosis
irrit	Irritation	nau	Nausea
irrity	Irritability		(Continued)

dilated pupils, lac; ner, musc ftg. insom; pares; derm; liver, kidney damage. Table 5 starts on page xxxiii and is three an one-half pages (includes target organs). Page xxxiv is printed below.

The third **Health hazards** column is **First Aid (See Table 6)**. Recommended first aid for exposure to toluene is:

Eye:	**Irr immed**
Skin:	**Soap wash prompt**
Breath:	**Resp support**
Swallow:	**Medical attention immed**

Table 6 begins on page xxxvii and is four pages. Definitions for some of the abbreviations used above and others are provided. For example:

Breath:

Resp support .... If a person breathes large amounts of this chemical, move the exposed person to fresh air at once. If breathing has stopped, perform

mouth-to-mouth resuscitation. Keep the affected person warm and at rest. Get medical attention as soon as possible.

The fourth and final **Health hazards** column and fourteenth and final column of the two-page flat on toluene is **Target organs (See Table 5)**. The target organs for toluene are **eyes, skin, resp sys, CNS, liver, kidneys**. Table 5 will tell you that **resp sys** is the respiratory system and **CNS** is the central nervous system. The three and one-half pages of Table 5 contain many more abbreviations for our body's organs.

National Institute for Occupational Safety and Health

NIOSH • Delivering on the Nation's promise: Safety and health at work for all people through research and prevention

Back Cover

Glossary

ABBREVIATIONS AND ACRONYMS

ACGIH	American Conference of Governmental Industrial Hygienists
ACM	Asbestos Containing Material
ANSI	American National Standards Institute
APR	Air-Purifying Respirator
atm	Atmosphere, a measure of pressure.
BP	Boiling Point
˚C	Celsius, Centigrade; International temperature scale in which boiling is 100 ˚C and freezing is 0 ˚C.
CAS	Chemical Abstracts Service
cfm	Cubic Feet per Minute
CFR	Code of Federal Regulations
CGI	Combustible Gas Indicator
C	Ceiling Limit
cm	Centimeter (measure of length, 1 cm = 0.394 in)
cm^2	Square Centimeter
cm^3 or cc	Cubic Centimeter
CNS	Central Nervous System
CPC	Chemical-Protective Clothing
CPR	Cardiopulmonary Resuscitation
CRC	Contamination Reduction Corridor
CRZ	Contamination Reduction Zone
dB	Decibels (measure of sound intensity)

DOD	U.S. Department of Defense
DOE	U.S. Department of Energy
DOT	U.S. Department of Transportation
EL	Excursion Limit
EPA	Environmental Protection Agency
ERP	Emergency Response Plan
f	Fiber
FID	Flame Ionization Detector
Fl. P. or FP	Flash Point
FRZ	Freezing Point for liquids and gases
g	Gram
GFI or GFCI	Ground Fault (Circuit) Interrupter
HEPA	High Efficiency Particulate Air
IARC	International Agency for Research on Cancer
IDLH	Immediately Dangerous to Life or Health
IP	Ionization Potential
l	Liter
LEL	Lower Explosive Limit
LFL	Lower Flammable Limit
m	Meter
m^2	Square Meter
m^3	Cubic Meter
mg	Milligram

mil	a measure of thickness
ml	Milliliter
mm	Millimeter
mmHg	Millimeters of mercury
MP or MLT	Melting Point
MSDS	Material Safety Data Sheet
MW	Molecular Weight
NFPA	National Fire Protection Association
NIOSH	National Institute for Occupational Safety and Health
NPL	National Priority List
ORM	Other Regulated Material
OSHA	Occupational Safety and Health Administration
PAPR	Powered Air-Purifying Respirator
PCB	Polychlorinated Biphenyl
PEL	Permissible Exposure Limit (OSHA)
PF	Protection Factor
PID	Photoionization Detector (monitor)
PPE	Personal Protective Equipment
ppm	Parts Per Million
PRCS	Permit-Required Confined Space
psi	Pounds Per Square Inch
REL	Recommended Exposure Limit (NIOSH)
SAR	Supplied-air Respirator (Type C System)

SCBA	Self-Contained Breathing Apparatus
SG	Specific Gravity
SOL	Solubility in Water
SOP	Standard Operating Procedure
Sp. Gr. or SG	Specific Gravity
STEL	Short-Term Exposure Limit
TLV	Threshold Limit Value
TLV-C	Threshold Limit Value—Ceiling
TLV-STEL	Threshold Limit Value—Short-Term Exposure Limit
TSDF	Treatment, Storage, and Disposal Facility
TWA	Time-Weighted Average
UEL	Upper Explosive Limit
UFL	Upper Flammable Limit
μg	Microgram (millionth of a gram)
μm	Micron or Micrometer (1/1000 mm or 0.001 mm)
USCG	U.S. Coast Guard
VOC	Volatile Organic Compound
VD	Vapor Density (air = 1)
VP	Vapor Pressure (air = 760 mmHg)

GLOSSARY

A

Absorption—a route of entry into the body by which chemicals are absorbed through the skin.

Acid—a chemical with a pH between 1 and 6.9 with the strongest acids having the lowest pH. Acids are sour, turn litmus red and can cause skin or tissue damage (pH goes from 1-14).

Acute effect—an adverse health effect which develops rapidly. Common acute effects include dizziness, headache, difficulty breathing, eye and throat irritation.

Additive effect—one in which the combined effect of two chemicals is equal to the sum of the agents acting alone.

Administrative controls—work and personnel practices that reduce exposure to chemical and physical hazards.

Adsorbent—a substance that holds other substances. Adsorbents such as activated carbon are used to remove odors and vapors.

Air-purifying respirator—protective mask with absorbent filters that remove toxic materials form the air.

Alkali—a base: any chemical with a pH above 7 and up to 14. Alkalis are bitter and turn litmus paper blue.

Alpha particle—positively charged radioactive particle capable of traveling only a few inches in air. Although it cannot penetrate the skin it does a lot of damage if it gets into the body.

Alveoli—the small air spaces deep in the lung where oxygen goes into the blood.

American Conference of Governmental Industrial Hygienists (ACGIH)—A private organization that develops and publishes recommended occupational exposure limits (see TLV).

Anhydrous—inorganic compound that does not contain water.

Asphyxiant—a vapor or gas which can cause unconsciousness or death by suffocation (lack of oxygen). Asphyxiation is a major hazard of confined spaces.

B

Base—see alkali

Beta particle—a radiation particle which can cause skin burns and harm if inside the body. Beta particles can be stopped by a thin sheet of metal.

Boiling point—temperature at which a liquid changes to a vapor.

Buddy system—a safety measure where workers, especially those exposed to hazards work in pairs.

C

Carcinogen—a substance which can cause cancer.

CAS Number—a unique number assigned to a chemical by the Chemical Abstract Service.

Catalyst—a substance that speeds up a chemical reaction.

cm^3 (cc)—cubic centimeter, a metric measurement (cm x cm x cm) about the size of a sugar cube.

Ceiling (C)—the maximum allowable exposure limit for an airborne substance, not to be exceeded during the shift.

Central Nervous System (CNS)—The brain and the spinal cord.

Chemical cartridge—a filtering device which is attached to an air-purifying respirator.

Chemical-resistant material—prevents chemicals from penetrating through your clothes to your skin.

Chronic effect—an adverse health effect which develops slowly over a long period of time.

Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)—The "Superfund" law administered by the EPA, regulates clean-up of hazardous waste.

Concentration—the amount of one material in another, i.e. the amount of a chemical vapor in air.

Confined space—space with limited access, poor natural ventilation and not intended for continuous human occupancy.

Corrosive—a liquid or solid that eats away another material or skin. Both acids and bases (alkalis) are corrosive.

D

Decibels—a unit of measurement of noise levels.

Decomposition—the breakdown of a material by heat, chemical reaction, decay, or other processes.

Decontamination—the chemical or physical process of reducing and preventing the spread of contamination from persons and equipment.

Decontamination line—a line set up with stations for decontamination procedures between the Hot Zone and the Cold Zone.

Degradation—process which diminishes or destroys protective properties of chemical protective clothing.

Department of Transportation (DOT)—Government agency that regulates shipments and transfer of hazardous materials.

Dermatitis—redness or irritation of the skin often caused by chemical exposures.

Dilution—method of reducing the concentration of a contaminant, generally in air or water by adding more air or water.

Dose—the quantity of a chemical taken into the body.

Dose response—the relationship between the amount of the chemical and the severity of response in humans or animals.

E

Emergency response plan—A written plan detailing actions and personnel responsibilities during chemical emergencies.

Engineering control—substitution, isolation, and ventilation methods used to reduce the level of the contaminant at the source.

Environmental Protection Agency (EPA)—federal agency concerned with the quality of the air, water, and land.

Evaporation rate—how fast a liquid becomes a vapor

Exclusion zone —The Hot Zone or contaminated area.

Exposure—the concentration of a material in the air to which a worker can come into contact. Usually, exposure is measured within the worker's breathing zone.

F

Flammable—The ability of a material to ignite and burn. According to OSHA, flammable liquids have flashpoints below 140º F.

Flash Point—the temperature at which a liquid will give off enough vapors that they will burn if ignited.

G

Gram (g)—a metric unit of weight. 454g = 1 pound.

H

Hazardous material—A chemical which is either flammable, corrosive, reactive or toxic.

Hazardous Waste Operations and Emergency Response (HAZWOPER)—OSHA standard which was developed to protect hazardous waste personnel and emergency responders.

Hazards—the properties of a material that may cause injury, or death by contact, inhalation, or ingestion.

HAZCOM—OSHA Hazard Communication Standard (1910.1200).

Heat exhaustion—prolonged exposure to intense heat exceeds the body's ability to cool down, causing excessive sweating and sodium deficiency.

Heat stroke—a life-threatening condition requiring medical attention in which the body is unable to sweat; skin is hot and dry.

Heavy metals—the major toxic metals, for example; mercury and arsenic.

Hematotoxin—toxic to the blood or organs where blood is made. "Hem-" or "Hema-" or "Hemo-" has to do with blood, as on "**hemo**lysis," which means bursting blood cells.

Hepatotoxin—toxic to the liver. "Hep-" or "Hepat-" has to do with the liver, as in "**hepat**itis," which means swelling of the liver, usually caused by a germ (virus or bacteria), but can also caused by some chemicals.

I

Immediately Dangerous to Life or Health (IDLH)—According to the OSHA respiratory Protection Standard, "an atmosphere that poses an immediate threat to life, would cause irreversible adverse health effects, or would impair an individual's ability to escape from a dangerous atmosphere."

Incident Command System (ICS)—an organized system of personnel and delegation of responsibilities which controls the response to an emergency.

Incident commander—person in charge of on-site management of all activities at a hazardous materials emergency.

Incompatible chemicals—chemicals which produce a negative reaction when mixed.

Ingestion—taking a substance in through the mouth.

Inhalation—Breathing in substances (usually as gas, vapor, fume, mist, or dust). The most common route of entry for workplace chemical exposures.

Irritant—a substance which causes an inflammatory response when brought into contact with the eyes, skin, or respiratory system.

Isolation—method of decontamination in which contaminated equipment and materials are bagged or covered and set aside, usually for subsequent shipment to an approved landfill for disposal.

L

Latency—the time interval between exposure to a substance and the development of a disease.

Lock-out—a procedure to prevent energy from reaching equipment being serviced or repaired. Energy source is locked out and the equipment tagged off.

Lower explosive limit—the lowest concentration (percentage of the substance in air) that will burn when an ignition source is present.

M

M—meter; a metric unit of length equal to about 39 inches

M^3—cubic meter-a measure of volume, close to a yard X a yard X a yard.

Manifest form—required by EPA to track hazardous wastes.

Material Safety Data Sheet (MSDS)—chemical information sheet required by OSHA's Hazard Communication Standard. Lists health effects, chemical properties, emergency response actions, reactivity data, control measures, safe handling procedures, etc.

Melting point—the temperature at which a solid substance changes to a liquid state.

Metabolism—the chemical reactions that go on in the body to maintain life.

Milligrams per cubic meter (mg/m^3)—unit of measurement which is a weight per unit volume of air.

Monitoring—measuring concentrations of substances in the workplace.

Mutagen—a substance which can change the genetic material (DNA) in a living cell.

N

National Fire Protection Association (NFPA)—produces fire standards, and the four-color diamond used on labels to indicate hazard.

National Institute for Environmental Health Sciences (NIEHS)—a federal agency responsible for issues related to the environment.

National Institute for Occupational Safety and Health (NIOSH)—The federal occupational health and safety research agency.

Neurotoxin—a substance which is toxic to the brain and nerves.

Neutralization—method of decontamination in which a chemical is mixed with another chemical to lessen the hazards.

Nuclear Regulatory Commission—a federal agency responsible for community and worker protection from radiation hazards.

O

Occupational Safety and Health Administration (OSHA)—a federal unit responsible for creating and enforcing occupational safety and health regulations.

Oxidation—a reaction in which a substance combines with oxygen, rusting is an example of oxidation.

Oxidizer—a substance that gives up oxygen readily.

Oxygen-deficient—air which contains less than 19.5% oxygen.

Oxygen-enriched—air containing more than 23.5% oxygen.

P

Parts per million (ppm)—a volume measure of chemical concentration. For example one part of chemical in a million parts of air.

Penetration—the flow of a chemical through zippers, stitched seams, pores, or imperfections in the material.

Permeation—process by which a chemical dissolves in or moves through a protective clothing material on a molecular level.

Permissible Exposure Limit (**PEL)**— set and enforced by OSHA is the highest concentration of a substance to which a person can be legally exposed during a typical weekday.

pH—measures acidity/alkalinity of substances and ranges from 1 to 14. Strong bases are closer to 14, strong acids closer to 1 water, pH 7, is neutral.

Physical agent—light, heat, cold, noise, radiation, vibration, etc. which affect health and safety.

Pulmonary toxin—a substance which is toxic to the lungs.

Q

Qualitative fit-test—measures effectiveness of a respirator by exposing wearer to a test atmosphere containing an irritating or smelly substance. Wearer should not be able to detect the substance.

Quantitative fit test—measures effectiveness of a respirator in preventing substance from entering the facepiece while wearer is in a test chamber. Concentration of substance is measured inside the facepiece of the respirator.

R

Rad—A measure of radiation energy absorbed by the body.

Reactivity—tendency of a substance to undergo chemical reaction with the release of energy.

REM—Roentgen Equivalent Man, a measure of radiation dose.

Renal—pertaining to the kidney.

Residual volume (RV)—the amount of air remaining in the lung after breathing out.

Risk—the chance of injury or loss.

Route of Entry—how material gets into the body: inhaled, ingested, through skin or eye contact absorption.

S

Self-Contained Breathing Apparatus (SCBA)—a supplied-air respirator with an air tank carried on wearer's back.

Sensitizer—a substance which on first exposure causes little or no reaction but which on repeated exposure may cause a marked serious allergic response.

Short-Term Exposure Limit (STEL)—the maximum concentration of a chemical a worker can be exposed to during a 15-minute period, set by OSHA.

Solubility (in water)—a measure of how much of a material will dissolve in water.

Stability—ability of a material to remain unchanged. A material is considered stable if it remains in the same form under expected and reasonable conditions of storage or use.

Standard Operating Procedures (SOP)—written descriptions of tasks and activities to be followed during work.

Support zone (cold zone)—area where administrative and support functions not requiring respiratory protective equipment are performed.

Synergistic Effect—a combined effect of two or more substances which is greater than the sum of the effect of each.

Systemic—relating to the whole body

T

Teratogen—a substance which can cause birth defects in a developing fetus.

Threshold—the lowest dose or exposure to a chemical at which a specific effect is observed.

Threshold Limit Value (TLV)—A concentration limit similar to the OSHA PEL TLVs are set by ACGIH and not legally enforceable.

Time-Weighted Average (TWA)—measurement to determine the worker's average exposure to a substance over a typical 8-hour work shift. OSHA PELs are time weighted averages.

Toxicity—Ability of a chemical to cause health damage.

U

United Nations Identification Number (UN Number)—A number used internationally to identify a hazardous material.

United States Coast Guard (USCG)—concerned with the transportation of hazardous materials on navigable waterways.

Upper Explosive Limit or Upper Flammable Limit (UEL/UFL)—The highest concentration (percentage of the substance in air) that will burn when an ignition source is present. At higher concentration, the mixture is too "rich" to burn. Also see "LEL."

V

Vapor—gaseous form of a substance normally in the liquid or solid state at room temperature.

Vapor density—the weight of a vapor or gas compared to air. Materials lighter than air have vapor densities less than 1.0. Materials heavier than air have vapor densities greater than 1.0. Also called Relative Gas Density or RGasD.

Vapor pressure—indicates the tendency of a liquid to evaporate into the air. Normal air has a vapor pressure of 760 mmHg at sea level (less at higher elevations).

Ventilation—Fans: a form of engineering control that removes (or dilutes) airborne contaminants.

Viscosity—resistance to flow.