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Chapter 1

Government Regulations/ Introduction to HAZWOPER

Why OSHA Exists

- OSHA began because, until 1970, there were no national laws for safety and health hazards.
- On average, 15 workers die every day from job injuries
- Over 5,600 Americans die from workplace injuries annually
- Over 4 million non-fatal workplace injuries and illnesses are reported

OSHA stands for the Occupational Safety and Health Administration, an agency of the U.S. Department of Labor. OSHA's responsibility is worker safety and health protection

- On December 29, 1970, President Nixon signed the OSH Act
- This Act created OSHA, the agency, which formally came into being on April 28, 1971

OSHA's Mission

The mission of OSHA is to save lives, prevent injuries and protect the health of America's workers. Some of the things OSHA does to carry out its mission:

- Developing job safety and health standards and enforcing them through worksite inspections,
- Maintaining a reporting and recordkeeping system to keep track of job-related injuries and illnesses, and
- Providing training programs to increase knowledge about occupational safety and health.

What Rights Do You Have Under OSHA?

You have the right to:

- A safe and healthful workplace
- Know about hazardous chemicals
- Information about injuries and illnesses in your workplace
- Complain or request hazard correction from employer
- Training
- Hazard exposure and medical records
- File a complaint with OSHA
- Participate in an OSHA inspection
- Be free from retaliation for exercising safety and health rights

Section 5(a)(1) of the OSH Act states: "Each employer shall furnish to each of his employees employment and a place of employment which are free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees."

Employers must have a written, complete hazard communication program that includes information on:

- Container labeling,

- Safety Data Sheets (SDSs), and
- Worker training. The training must include the physical and health hazards of the chemicals and how workers can protect themselves; including specific procedures the employer has implemented to protect workers, such as work practices, emergency procedures, and personal protective equipment.

OSHA's Recordkeeping rule requires most employers with more than 10 workers to keep a log of injuries and illnesses.

Workers have the right to review the current log, as well as the logs stored for the past 5 years.

Workers also have the right to view the annually posted summary of the injuries and illnesses (OSHA 300A).

Workers may bring up safety and health concerns in the workplace to their employers without fear of discharge or discrimination, as long as the complaint is made in good faith.

OSHA regulations [29CFR 1977.9(c)] protect workers who complain to their employer about unsafe or unhealthful conditions in the workplace.

Workers have a right to get training from employers on a variety of health and safety hazards and standards that employers must follow.

Some required training covers topics such as, lockout-tagout, bloodborne pathogens, noise, confined spaces, fall hazards in construction, personal protective equipment, along with a variety of other subjects.

You have a right to examine & copy records

Examples of toxic substances and harmful physical agents are:

- Metals and dusts, such as, lead, cadmium, and silica.
- Biological agents, such as bacteria, viruses, and fungi.
- Physical stress, such as noise, heat, cold, vibration, repetitive motion, and ionizing and non-ionizing radiation.

Workers may file a complaint with OSHA if they believe a violation of a safety or health standard, or an imminent danger situation, exists in the workplace.

Workers may request that their name not be revealed to the employer.

If a worker files a complaint, they have the right to find out OSHA's action on the complaint and request a review if an inspection is not made.

Employee representative can accompany OSHA inspector

Workers can talk to the inspector privately.

Workers may point out hazards, describe injuries, illnesses or near misses that resulted from those hazards and describe any concern you have about a safety or health issue.

Workers can find out about inspection results, abatement measures and may object to dates set for violation to be corrected.

Workers have the right to be free from retaliation for exercising safety and health rights.

Workers have a right to seek safety and health on the job without fear of punishment.

This right is spelled out in Section 11(c) of the OSH Act.

Workers have 30 days to contact OSHA if they feel they have been punished for exercising their safety and health rights.

Employer Responsibilities

- Workers have the right to be free from retaliation for exercising safety and health rights.
- Workers have a right to seek safety and health on the job without fear of punishment.
- This right is spelled out in Section 11(c) of the OSH Act.
- Workers have 30 days to contact OSHA if they feel they have been punished for exercising their safety and health rights.

Employers must:

- Report each worker death
- Report each incident that hospitalizes 3 or more workers
- Maintain injury & illness records
- Inform workers how to report an injury or illness to the employer
- Make records available to workers
- Allow OSHA access to records
- Post annual summary of injuries & illnesses
- Determine if PPE should be used to protect their workers.

OSHA standards fall into four categories: General Industry, Construction, Maritime, and Agriculture.

OSHA issues standards for a wide variety of workplace hazards

Where there are no specific OSHA standards, employers must comply with The General Duty Clause, Section 5(a)(1)

The OSH Act authorizes OSHA compliance safety and health officers (CSHOs) to conduct workplace inspections at reasonable times.

OSHA conducts inspections without advance notice, except in rare circumstances (e.g. Imminent Danger)

In fact, anyone who tells an employer about an OSHA inspection in advance can receive fines and a jail term.

Priority	Category of Inspection
1st	**Imminent Danger:** *Reasonable certainty an immediate danger exists*
2nd	**Fatality/Catastrophe:** *Reported to OSHA; inspected ASAP*
3rd	**Complaints/Referrals:** *Worker or worker representative can file a complaint about a safety or health hazard*
4th	**Programmed Inspections:** *Cover industries and employers with high injury and illness rates, specific hazards, or other exposures.*

Chapter 2

Health and Safety Plans

Before any work takes place on a HAZWOPER (Hazardous Waste Operations and Emergency Response) site a HASP (Health and Safety Plan) plan must be created. The document outlines the hazards faced on project and the procedures and policies needed to ensure the health and safety for the workers as well as the public. The plan is specific to the site conditions.

Before workers are allowed to be on site the employees are to review the plan. The plan is kept on site available for all workers to access. The plan is a living breathing document and may be changed periodically throughout the project.

Each project has a Site Safety and Health Officer (SSHO) designated for each site. The SSHO is responsible for making sure the HASP is carried out. He is also available for questions from site workers. In addition, the SSHO does site audits and inspections to ensure that the plan is effective and that the workers are following the plan.

In addition to the procedures for site work, the HASP will have information for emergencies that may arise at the site. These include physical injuries and environmental spills.

The HASP contains 10 elements:

- Health and safety risk or hazard analysis
- Employee Training
- Person protective equipment (PPE)
- Specific medical monitoring
- Air monitoring
- Site control
- Decontamination
- Emergency response
- Confined spaces
- Spill containment

Health and Safety Risk or Hazard Analysis

There are three steps for risk and hazard analysis, **off-site characteristic, on-site survey and assessment**s, and **ongoing monitoring**. Research and evaluation is done off-site away from the hazards. This process is to protect the workers before the work activity begins. Hazards such as atmosphere and other conditions that may be encounter are researched. These conditions include any Immediately Dangerous Conditions (IDLH) that may exist on the site. IDLH conditions include:

- Confined spaces
- Bulging drums, foaming or gas generation
- Extremely hazardous materials
- Visible vapor clouds
- Biological indictors (dead animals, vegetation)
- Strange odors

This information is obtained through like projects, research of records, those who worked at the site or a survey of the site's perimeter. Here are some examples of data that can be obtained before site entry:

- Site and topographic maps, geological surveys, and photographs
- Previous surveying, sampling, and monitoring data
- Meteorological and ground water data
- Site, generator, transporter, and utility records
- Federal, state and local regulatory and enforcement agency records
- Waste storage inventories, manifests, and shipping papers
- Interviews with workers and nearby residents
- Media reports

On-site Survey and Assessments

Based on the information gained from the off-site survey, a better idea of the site conditions should help with the hazards present on the site. Even though some information is gained from the off site assessment, caution will need to be exercised. If unknown hazards are present, Level B PPE is the minimum level of protection recommended for entering the site the first time. Monitoring and a visual survey should be conducted as well as soil and water sampling.

A typical entry team consists of two fully protected entrants and two outside support personnel who have PPE prepared in case of an emergency. The survey will identify hazards such as location, size, topography, and accessibility to the site for the purpose of establishing zones.

There are usually three zones, **exclusion zone, contamination reduction zone,** and **support zone**.

Ongoing Monitoring

Ongoing monitoring provides the SSHO with data that will help when assessing whether or not the HASP needs changing. One example would be a change of airborne contaminates.

Employee Training

OSHA requires that workers are properly trained and prepared before hazardous work is performed. Workers who perform work typically obtain a minimum of 40 hours of training. Before any worker is allowed to work without supervision, a minimum of three days of field experience is required. Field experience is important for assessing site terrain, unfamiliar types of cleanup work, unstable ground and unusual containers.

Type of Employee	Training Required
Routine site employees	40 hours classroom training 24 hours supervised field experience
Occasional and routine site employees unlikely to be exposed above permissible exposure limits	24 hours classroom training 8 hours supervised field experience
Supervisors	40 hours classroom training 8 hours supervisory training
Site employees assigned site emergency response duties	40 hours classroom training Training to a level of competency
All site workers	8 hours annually refresher training

Person Protective Equipment

The HASP will outline the specific details of the PPE that is required for the site. The SSHO will train workers on any additional PPE that might be needed on the site such as SCBA.

Specific Medical Monitoring

The HASP will identify any monitoring that is required for the site. The monitoring can vary based on site conditions and the different task that employees are assigned to perform.

Air monitoring

Airborne hazards are one of the most dangerous hazards you are exposed to when hazardous materials are present. Respiratory protection is so important. A couple of breaths of the wrong hazard could prove deadly.

When air monitoring is performed, full protection must be worn until the results of air monitoring show that the hazard is not present or controlled. Monitoring will be outlined in the HASP. Below is an example of what one might look like:

Air Monitoring Action Levels

Monitoring Device	Result	Action Required
Photoionization Detector	0 to 10 units above background sustained for 1 minute	• Continue Periodic Monitoring
	10 to 25 units above background sustained for 1 minute	• Collect a benzene or vinyl chloride sample with colorimetric detector tubes • Continue Periodic Monitoring
	> 25 units above background sustained for 1 minute	• Cease operations until Supervisor has evaluated the situation • Collect a benzene or vinyl chloride sample with colorimetric detector tubes
Detector Tubes for Benzene or Vinyl Chloride	< 0.5 ppm	• Continue Periodic Monitoring
	> 0.5 ppm	• Cease operations until Supervisor has evaluated the situation • Collect a benzene or vinyl chloride sample with colorimetric detector tubes • If level does not drop below 0.5 ppm, notify the project CIH who will decide whether to modify the plan and upgrade including respiratory protection
Notes: *< = Less than* *> = Greater than* *ppm = parts per million in air*		

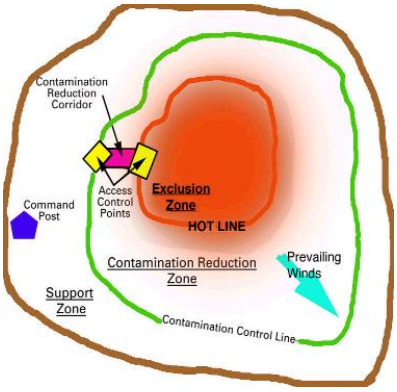
Site Control

Site control is an effective method to reduce worker contamination. It will also prevent the contamination from spreading outside the site through workers or equipment. The HASP should include the following items:

- Security and physical barriers which exclude unnecessary personnel from the general area.
- The minimum number of workers and equipment needed for a job.
- Work zones are established.
- Control points to regulate access to work zones.
- How operations will reduce personnel and equipment exposure to hazards.
- Decontamination procedures in place.

The following items are also covered in a HASP when addressing site control:

- **Site map**
  - Shows the topography of the site, prevailing wind direction, drainage, and the location of buildings, containers, impoundments, pits, ponds, and streams. In addition, it may contain evacuation routes and problem areas.
- **Work Zones**
  - Typically, there are three zones:
    - The exclusion zone is where the hazardous materials present and where contamination occurs, sometimes referred to as the "Hot Zone"
    - The contamination zone is where decontamination takes place. It is a transition area between the contaminated exclusion zone and the clean support zone. Typically, there are two contamination zones, one for workers and one for equipment.
    - The support zone is the outermost part of the site and is considered a non-contaminated zone. Command post is always in this zone.



- **Buddy System**

This is a SOP when working in a hazardous area. The purpose is for support when something goes wrong. Some examples would include, PPE and heat stress. The buddy system begins at the Exclusion Zone.

- **Site Security**

Site security is important to prevent unauthorized, unprotected people from entering the site possibly exposing them to hazards. In addition, it is to help protect against vandals, illegal dumping and theft. A fence in the best way to keep the area secure. A person should be assigned to inspect the fence each day before leaving for the day.

- **Site Communication**

External and internal communications are needed. External may be fire department, police and emergency rescue. Internal communication is used to notify workers of emergencies, work changes and

any other information needed for the job. The way to communicate is determined beforehand and must be evaluated for effectiveness.

- **Standard Operating Procedures (SOP)**

These procedures are typical with any other job. They may be standard operations for equipment use or proper care of PPE.

Decontamination

The HASP will contain any specific information for the proper decontamination methods and disposal of contaminated materials. The place for this decontamination will be outlined in the HASP.

Emergency Response

Emergency response requires advanced planning. Your role may be to evacuate the area or much more involved. If an emergency response is performed internally a well-developed program will be written.

Confined Spaces

The HASP will have a dedicated program for the training of workers performing activities inside of confined spaces.

Spill Containment

Spills can be one of the biggest risk on a clean-up site. Exposures can escalate or contaminate a water way in seconds. The HASP will outline the steps in reducing and containing spills. In addition, what authorities will need to be notified. The plan may include what size of spill will need notification to proper authorities. As a general rule, any contaminate that cannot be captured and will adversely affect others or the environment will need immediate attention from a supervisor.

Prevention is the most important strategy. Effective spill containment plans will include such as drum container handling and proper storage.

Containing a spill may include berms, dikes, diversion, trenches or ditches. Collection pans under equipment and inspection after a heavy rain should also be covered.

Vanadium worksheet

You are the site safety and health officer and are in charge of creating health and safety plans. Answer the questions based on the scenario provided as you work to create a health and safety plan.

Scenario

Vanadium is a soft, silvery gray element used in making alloys used in the production of steel. It makes steel stronger. It is used in a form called ferrovanadium in steel production. You and your crew have been assigned to a plant that processed vanadium for a number of steel mills that were 5-10 miles away by rail. The site, which is blanketed in vanadium ash nearly everywhere, has been abandoned for 25 years, but the rural area around the plant is now being developed mainly for housing. The EPA has contracted for cleanup of the site. The plant building itself still stands on a plot of land about a half-mile long. A working railroad line travels through the site. A two-lane road runs along the front of the plant, and a large creek that feeds into a river where the steel mills are is just on the other side of the road. A mountain of white slurry waste- the ash- that had been pumped up the large hills directly behind the plant for disposal still towers behind the dilapidated plant. The grounds of the site feature smaller piles of the ash at various places, and vehicles traveling through the site accumulate the dust on tires and the vehicle. Also piled at a couple of spots around the outside of the building are unmarked 55-gallon drums whose contents are not immediately known.

1. What is the health and safety risk of cleaning up the site?

2. What kind of employee training is necessary to work at this site?

3. What personal protective equipment is needed?

4. What kind of specific medical monitoring might be needed?

5. Will air monitoring be necessary?

6. What kind of site control is required?

7. Is decontamination necessary?
8. What kind of emergency response plan should be put in place?

9. Are confined spaces an issue?

10. What kind of spill containment plans must be in place?

Vanadium dust	**Formula:** V_2O_5	**CAS#:** 1314-62-1	**RTECS#:** YW2450000	**IDLH:** 35 mg/m^3 (as V)
Conversion:	**DOT:** 2862 151			

Synonyms/Trade Names: Divanadium pentoxide dust, Vanadic anhydride dust, Vanadium oxide dust, Vanadium pentaoxide dust. Other synonyms vary depending upon the specific vanadium compound.

Exposure Limits:	**Measurement Methods (see Table 1):**
NIOSH REL*: C 0.05 mg V/m^3 [15-minute] [***Note:** The REL applies to all vanadium compounds except Vanadium metal and Vanadium carbide (see Ferrovanadium dust).] **OSHA PEL†:** C 0.5 mg V_2O_5/m^3 (resp)	**NIOSH** 7300, 7301, 7303, 7504, 9102 **OSHA** ID185

Physical Description: Yellow-orange powder or dark-gray, odorless flakes dispersed in air.

Chemical & Physical Properties:	**Personal Protection/Sanitation (see Table 2):**	**Respirator Recommendations (see Tables 3 and 4):**
MW: 181.9 **BP:** 3182°F (Decomposes) **Sol:** 0.8% **Fl.P:** NA **IP:** NA **Sp.Gr:** 3.36 **VP:** 0 mmHg (approx) **MLT:** 1274°F **UEL:** NA **LEL:** NA Noncombustible Solid, but may increase intensity of fire when in contact with combustible materials.	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet or contam **Change:** N.R.	**NIOSH** (as V) **0.5 mg/m^3:** 100XQ*/Sa* **1.25 mg/m^3:** Sa:Cf*/PaprHie* **2.5 mg/m^3:** 100F/PaprTHie*/ScbaF/SaF **35 mg/m^3:** SaF:Pd,Pp **§:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** 100F/ScbaE

Incompatibilities and Reactivities: Lithium, chlorine trifluoride

Exposure Routes, Symptoms, Target Organs (see Table 5):	**First Aid (see Table 6):**
ER: Inh, Ing, Con **SY:** Irrit eyes, skin, throat; green tongue, metallic taste, eczema; cough; fine rales, wheez, bron, dysp **TO:** Eyes, skin, resp sys	**Eye:** Irr immed **Skin:** Soap wash prompt **Breath:** Resp support **Swallow:** Medical attention immed

Review Questions:

1. You notice a problem at the hazardous worksite after you have begun working. Whom should you contact about your concern?

2. What is the general purpose of the site characterization plan?

3. How many members make up the initial entry team that performs the on-site assessment and survey, and how will they be protected?

4. Draw and label a diagram of the three work zones of a site that prevent or reduce the movement of contaminants:

5. Define the exclusion zone:

6. Is the buddy system a SOP on a hazardous worksite?

7. Give an example of when a HASP might have to be revised:

Chapter 3

Toxicology

Toxicology is the study of the nature and actions of chemicals in the body. Toxicity is the capacity of a chemical to harm a living organism.

All substances are potentially toxic. A good example is water. Our body needs water, but too much water can be deadly. The simple reason water does not hurt you is the dose.

This is true about chemicals. In the proper dose many chemicals are harmless. The only way to know the permissible dose is by a proper analysis.

Toxic potency of a chemical is the relationship between the dose and the response that is produced in a biological system. This is called the dose response relationship.

To understand the dose response relationship, the following equation is used:

C x T = Dose

Where C is the chemical concentration and T is the exposure time.

This equation is for the mainstream of chemicals. Extreme cases may occur at low doses or high doses.

Exposure falls into two main classifications, Acute and chronic. An example of each would be arsenic and asbestos.

Acute exposures are usually one-time, high level exposures and the symptoms are usually immediate although in some cases delayed. Another example of acute would be **carbon monoxide**. The effect will be seen in minutes if not seconds. A lower dose may take a few hours but it still considered an acute effect. If a chemical is spilled onto your skin, the effect may not show up until the next day, but that too is considered acute.

Even though the affects may wear off in a day does not mean that an acute exposure is not serious. Some exposures can cause permanent damage or death. Some examples of acute are:

- Inhaled contaminants: coughing, wheezing, nose and throat burning
- Skin contact: redness, rash, blistering
- Ingested contaminants: nausea, vomiting, diarrhea

It is important for you to pay attention to your health when working around hazardous chemicals and hazardous environments.

LD_{50} and LC_{50}

LD_{50} describes the acute toxicity of chemicals through ingestion. LD stands for lethal dose. 50 refers to the percentage of animals that died with the given dose(amount per body weight) for a predetermined time.

LD50 > 2000 mg/kg A-PMDI would be an example of how you would see it on a SDS.

Relative Toxicity	
Rating	**Rat Oral LD_{50} mg/kg**
1. Extremely toxic	1mg or less
2. Highly toxic	1-50 mg
3. Moderately toxic	50 -500 mg
4. Slightly toxic	500-5,000 mg
5. Practically nontoxic	5,000-15,000 mg
6. Relatively harmless	15,000 mg or more

What is the LD_{50} of Benzene? _____

LC_{50} (Lethal Concentration) describes the acute toxicity of chemicals through inhalation.

Relative Toxicity	
Rating	**Rat Inhalation LC_{50} mg/m^3 or ppm**
1. Extremely toxic	< 10 ppm
2. Highly toxic	10-100 ppm
3. Moderately toxic	100 -1000 ppm
4. Slightly toxic	1000-10,000 ppm
5. Practically nontoxic	10,000-100,000 ppm
6. Relatively harmless	>100,000 ppm

Chronic

Chronic effects typically display these features:

- **Exposure**: Low-level exposure over a long period of time.
- **Effects**: Symptoms may not show up for 10 to 20 years

Asbestos is a good example of a chronic exposure. Workers have been exposed to asbestos for 20+ years with no significant signs of health concerns. Breathing these fibers day after day month after month will greatly affect the risk on your health, typically in the form of mesothelioma or lung cancer.

The latency period is the years from the time you were exposed to the time when symptoms begin to appear. For some diseases, such as cancer, the latency period can take 20 years or longer.

Some chemicals can be both acute and chronic. An example would be toluene. Toluene is a chemical used in paints and solvents. Immediate effects make you "high" longer exposure will cause liver failure and destroy brain cells.

Routes of Exposure

We wear PPE to prevent toxins from entering the body. There are four routes of entry.

- Inhalation
- Ingestion

- Absorption
- Injection

Inhalation

Inhalation is the most common route of entry and it is the most efficient. Air is brought into the body and oxygen and carbon dioxide is exchanged in the alveoli. The problem is that toxins also can be exchanged in the alveoli. Sometimes on purpose such as laughing gas and more often by accident like carbon monoxide.

You have 300 million alveoli and each has a one cell thick membrane. This thin layer allows for your body to make the exchange. If it is a toxin, then travels throughout the body.

Chemicals are inhaled in various forms:

- Dusts- i.e. silica and lead. Silica is very sharp and causes damage to the cell wall.
- Gasses-
- Mists- i.e. fog or water droplets
- Fumes- i.e. welding, paving operations and lead
- Fibers- most common is asbestos

Our respiratory system is without a doubt unparalleled in its ability to transfer contaminates to all parts of the body. Therefore, it can affect other areas of your body.

Ingestion

Swallowing a toxic chemical through the digestive tract is another efficient way of exposure. Entering through the mouth is as easy as not washing your hands before eating, therefore good hygiene is very important. Ingesting toxins through the digestive track can damage the digestive track as well as other part of the body.

Absorption

Your skin protects you better from contaminates better than your lungs or digestive system, but chemicals can still be absorbed through skin contact. Contact can be local or systemic.

Often the skin stops chemicals from entering the body usually resulting in an irritation or dermatitis. If your skin is broken, wet or hot it is easier for absorption to occur. Think of wet concrete. If your skin is wet the concrete can cause more injury than if dry. Your palms and feet are more resistant and areas such as armpits and eys are more easily affected.

Injection

Injection is the least common route of entry but toxins can be injected through puncture wounds, cuts or by high pressure. A simple example is a paint sprayer or hydraulic lines.

Chemicals in the Body

Your body does three things with a chemical. It can do just one or all three depending on the chemical.

- **Metabolize**: This is the process of breaking down a chemical by changing its composition. Sometimes this makes if less harmful, other times it makes it **more** harmful. An example is methylene chloride, furniture stripping agent. When metabolized, it produces carbon monoxide. Carbon monoxide interferes with the body's ability to carry oxygen. Results can be heart attacks or sudden death.
- **Store**: The body can store the chemical so that it can accumulate to dangerous levels later. Metals are a good example. The body needs metals, but not all metals and the body does not see the difference. Iron is good, mercury and lead are bad.
- **Excrete**: Of the body cannot absorb the toxin then it will simply pass it through the body.

Target Organs

Organs most affected are called target organs. The largest organ in the body by weight is the **skin**. It is possible for toxic chemicals to enter the bloodstream through the skin. Rashes or changes in the skin color or feel are clues to exposure.

Central nervous system. This includes the brain and spinal cord. Look for symptoms such as staggering, slurring of speech, dizziness, trembling and twitching to indicate exposure.

The **liver** helps digest fats, detoxify and stores sugar. Chronic exposure to some chemicals can cause liver damage. Indicators are yellow skin or jaundiced.

The **kidneys** filter blood, produce urine and keep proper acid balance. Urinating problems are indications of possible toxin exposure.

The **blood and blood forming systems** circulate oxygen, carbon dioxide.

The **reproductive system** includes all organisms necessary for fertilization, conception and gestation. Common problems are sterility, infertility and disrupted hormonal activity.

The **respiratory system** regulates the oxygen and carbon dioxide in the body. Breathing difficulties are an indicator.

The **eyes** translate light energy into impulses that the brain translate into images. Corrosives damage the eyes by direct contact. Some toxins go in through the eyes directly into the bloodstream.

The **digestive system** convert food into energy and moves waste material. Look for signs such as cramping or nausea to indicate exposure.

You are the best source of information of an exposure to a toxin. Listen to your body! If you are feeling sick or unusual, and have been working around toxins, let your doctor know. They may need to see a list of chemical you have been working with.

Another concern is chemical interactions. One chemical may be of no concern, but when combined with other chemicals it may be toxic.

Factors Determining Toxicity

Four main items determine toxicity. Below is a table outlining them:

Chemical	Exposure	Individual Susceptibility	Environmental
Composition Physical characteristics Physical properties Presence of impurities Breakdown products	Dose Concentration Route of exposure Duration	Health Age Sex Previous exposures Genetics Race	Media Additional chemicals present Temperature Humidity

Exposure Limits

Some Limitations

- They are often out of date as it takes an average of 10 years to make a change to OSHA regulations
- They are not written to protect people who may have developed sensitivities to certain chemicals
- OSHA's exposures limits were based on research done on the workforce in the late 1960's for a predominantly white male sample.
- OSHA's limits are designed to protect your health while also being economically feasible for the employer to maintain. They are not necessarily the most protective they can be of your health. Instead, they represent a political compromise.

PELs

OSHA regulations use Permissible Exposure Limits (PELs). These are important because they are the only exposure limits that are legally binding for an employer. PELs are reported in parts per million (ppm) or milligrams per cubic meter (mg/m^3). The lower the PEL, the greater the concern.

TLVs

Threshold Limit Values (TLVs) are the oldest exposure limits in existence. They were created by the American Conference of Governmental Industrial Hygienists. Since TLVs are based on an 8 hour day, OSHA adopted them in 1970.

NIOSH also has a set of exposure limit called Recommended Exposure Limits (RELs) for airborne concentrations of chemicals. The RELs (Recommended Exposure Limits) are based on 10 hours a day time weighted average.

SDS often contain all three (PEL, TLV, and REL). Important to remember only OSHA"s PEL is legally binding. (Except in states as Washington which has set its own limits -see WA Exposure Limits)

TWA

Time-weighted average (TWA) refers to concentrations of airborne toxic materials weighted for usually 8 hours. This represents a typical full day shift.

$$\frac{\text{(Measured Concentration x Hours Worked Within Concentration)}}{8 \text{ hours}} = \text{TWA}$$

Here is an example:

Assume that when the TWA is 20 ppm, your employer must ensure that you wear a respirator. A measurement is taken and found to have a concentration of a chemical at 18 ppm. You are going to work two hours and then take a 15 min break.

$$\frac{(18 \times 2)}{8} = \frac{36}{8} = 4.5 \text{ ppm}$$ All is good

Now you work another two hours before lunch and the concentration is 19 ppm.

$$\frac{(18 \times 2) + (19 \times 2)}{8} = \frac{74}{8} = 9.25 \text{ ppm}$$ All is still good

After lunch you work four hours at a concentration of 24 ppm.

$$\frac{(18 \times 2) + (19 \times 2) + (24 \times 4)}{8} = \frac{170}{8} = 21.25 \text{ ppm}$$ We are now over exposed.

If the worker limited his work day to 7 hours he would have remained under the limit even though the last three hours of the day would have been over the 20 ppm limit. This would be called Work Practice Controls and discussed later.

NIOSH Pocket Guide to Chemical Hazards was created as a guide for workplace hazards. It is downloadable for free at www.cdc.gov/niosh/npg/.

The best resourse is the chemical label or SDS which came with the product.

Here is an example highlighting some of the information:

Benzene	**Formula:** C_6H_6	**CAS#:** 71-43-2	**RTECS#:** CY1400000	**IDLH:** Ca [500 ppm]
Conversion: 1 ppm = 3.19 mg/m^3	**DOT:** 1114 130			
Synonyms/Trade Names: Benzol, Phenyl hydride				
Exposure Limits: **NIOSH REL:** Ca TWA 0.1 ppm ST 1 ppm See Appendix A **OSHA PEL:** [1910.1028] TWA 1 ppm ST 5 ppm See Appendix F			**Measurement Methods (see Table 1):** **NIOSH** 1500, 1501, 3700, 3800 **OSHA** 12, 1005	
Physical Description: Colorless to light-yellow liquid with an aromatic odor. [**Note:** A solid below 42°F.]				
Chemical & Physical Properties: **MW:** 78.1 **BP:** 176°F **Sol:** 0.07% **Fl.P:** 12°F **IP:** 9.24 eV **Sp.Gr:** 0.88 **VP:** 75 mmHg **FRZ:** 42°F **UEL:** 7.8% **LEL:** 1.2% Class IB Flammable Liquid	**Personal Protection/Sanitation (see Table 2):** **Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R. **Provide:** Eyewash Quick drench		**Respirator Recommendations (see Tables 3 and 4):** **NIOSH** **¥:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE **See Appendix E** (page 351)	
Incompatibilities and Reactivities: Strong oxidizers, many fluorides & perchlorates, nitric acid				
Exposure Routes, Symptoms, Target Organs (see Table 5): **ER:** Inh, Abs, Ing, Con **SY:** Irrit eyes, skin, nose, resp sys; dizz; head, nau, staggered gait; anor, lass; derm; bone marrow depres; [carc] **TO:** Eyes, skin, resp sys, blood, CNS, bone marrow [leukemia]			**First Aid (see Table 6):** **Eye:** Irr immed **Skin:** Soap wash immed **Breath:** Resp support **Swallow:** Medical attention immed	

IDLH

This section lists the Immediately Dangerous to Life and Health concentrations. This is a level set that allows the worker to escape without injury or irreversible health effects when there is an over exposure or failure of respiratory equipment. The safety margin was set for 30-minutes of exposure, however, the limit was NOT meant to imply that the worker can safely work an additional 30 minutes. IS TO BE MADE TO EXIT IMMEDIATELY. The "**Ca**" considers benzene a carcinogen.

Conversion Factor

This section list factors for the conversion of ppm to mg/m^3(milligrams of vapor or gas per cubic meter of contaminated air)

Exposure Limits

NIOSH recommended exposure limits (REL) are listed first. TWA indicates a time weighted average up to a 8 hr. work day during a 40 hr. work week. A short-term exposure limit (STEL). Unless otherwise noted the limit is 15 minutes of exposure. The ceiling is a REL and should not be exceeded at any time.

The difference between the REL and PEL is somewhat controversial. NIOSH is more stringent than OSHA but as stated above OSHA's are legally binding. OSHA has to set limits that protect your health and also have to be economically feasible for the employer to maintain, so they are a political compromise.

Physical Description

This section gives a brief description of the appearance and odor of each substance.

Chemical and Physical Properties

The following abbreviations are used for the chemical and physical properties given for each substance.

MW	Molecular weight
BP	Boiling point at 1 atmosphere, F
Sol	Solubility in water at 68 F
Fl.P	Flash point (the temperature at which the liquid phase gives off enough vapor to flash when exposed to an external ignition source)
IP	Ionization potential-this is used as a guideline for the selection of photoionization detector lamps used in some direct-reading instruments
VP	Vapor pressure at 68^0 F
MLT	Melting point for solids
FRZ	Freezing point for liquids and gasses
UEL	Upper explosive limit in air at room temperature given as a %
LEL	Lower explosive limit in air at room temperature given as a %
MEC	Minimum explosive concentration
Sp.Gr.	Specific gravity at 68^0 F as referenced to water
RGasD	Relative density of gasses referenced to air =1

When available:

Class IA flammable liquid	Fl.P. below 73^0 F and BP below 100^0 F
Class IB flammable liquid	Fl.P. below 73^0 F and BP at or above 100^0 F
Class IC flammable liquid	Fl.P. at or above 73^0 F and below 100^0 F
Class II flammable liquid	Fl.P. at or above 100^0 F and below 140^0 F
Class IIIA flammable liquid	Fl.P. below 140^0 F and below 200^0 F
Class IIIB flammable liquid	Fl.P. at or above 200^0 F

Personal Protection and Sanitation

This section presents a summary of recommended practices for each substance. These recommendations supplement general work practices and should be followed if additional controls are needed after using all feasible process, equipment and task controls.

Skin	Recommends the need for personal protective clothing
Eyes	Recommends the need for eye protection
Wash skin	Recommends when workers should wash the spilled chemical for the body in addition to normal washing(i.e. eating)
Remove	Advises workers when to remove clothing that has accidentally become wet or significantly contaminated
Change	Recommends whether the routine changing of clothing is needed

Provide	Recommends the need for eyewash fountains and/or quick drench facilities

Recommendations for Respirator Selection

This section provides a condensed table of allowable respirators to be used for those substances for which IDLH values have been determined, or for which NIOSH has previously provided respirator recommendations for certain chemicals.

Here are the recommendations for benzene:

APF = 10,000	Any self-contained breathing apparatus that has a full face piece and is operated in a pressure-demand or other positive-pressure mode.
APF = 10,000	Any supplied-air respirator that has a full face piece and is operated in a pressure-demand or other positive-pressure mode in combination with an auxiliary self-contained positive-pressure breathing apparatus.
Escape **APF = 50**	Any air-purifying, full-face piece respirator with a chin-style, front or back mounted organic vapor canister Any appropriate escape-type, self-contained breathing apparatus

Incompatibilities and Reactivities

This list important hazardous incompatibilities or reactivities for each substance.

For Benzene, these are strong oxidizers, many fluorides and perchlorates and nitric acid

Exposure Routes, Symptoms, and Target Organs

Exposure Routes	Toxicologically important routes of entry for each substance and whether contact with the skin or eyes is potentially hazardous
Symptoms	Potential symptoms for exposure and whether NIOSH considers the substance a potential occupational carcinogen
Target Organs	Lists organs affected by exposure to each substance.

First Aid

This section list emergency procedure for eyes and skin contact, inhalation and ingestion.

Toxicology/ Industrial Hygiene Discussion

You are assigned to a hazardous waste cleanup operation. You will be handling drums and other containers with various chemicals. To prepare yourself for working with these chemicals, you decide to research each of them using the NIOSH guide. Use the guide to answer the following questions.

1. A container is marked liquid acetaldehyde. What is the flash point for acetaldehyde?

2. Would acetaldehyde be considered one of the most flammable chemicals or least flammable chemicals you would encounter?

3. Drums are marked Systox®. What is another name for Systox?

4. What is Systox used as?

5. Air monitoring shows that there is a level of Systox of 2 mg/m^3 near the drums. Is a respirator necessary, and if so, what kind is recommended?

6. Which poses a more immediate danger to life and health (IDLH), the Systox or acetaldehyde, a compressed gas?

Acetaldehyde	**Formula:** CH_3CHO	**CAS#:** 75-07-0	**RTECS#:** AB1925000	**IDLH:** Ca [2000 ppm]
Conversion: 1 ppm = 1.80 mg/m^3	**DOT:** 1089 129			
Synonyms/Trade Names: Acetic aldehyde, Ethanal, Ethyl aldehyde				
Exposure Limits: **NIOSH REL:** Ca See Appendix A See Appendix C (Aldehydes) **OSHA PEL†:** TWA 200 ppm (360 mg/m^3)			**Measurement Methods (see Table 1):** **NIOSH** 2018, 2538, 3507 **OSHA** 68	
Physical Description: Colorless liquid or gas (above 69°F) with a pungent, fruity odor.				

Chemical & Physical Properties:	**Personal Protection/Sanitation (see Table 2):**	**Respirator Recommendations (see Tables 3 and 4):**
MW: 44.1 **BP:** 69°F **Sol:** Miscible **Fl.P:** -36°F **IP:** 10.22 eV **Sp.Gr:** 0.79 **VP:** 740 mmHg **FRZ:** -190°F **UEL:** 60% **LEL:** 4.0% Class IA Flammable Liquid	**Skin:** Prevent skin contact **Eyes:** Prevent eye contact **Wash skin:** When contam **Remove:** When wet (flamm) **Change:** N.R. **Provide:** Eyewash Quick drench	**NIOSH** **¥:** ScbaF:Pd,Pp/SaF:Pd,Pp:AScba **Escape:** GmFOv/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, acids, bases, alcohols, ammonia & amines, phenols, ketones, HCN, H_2S [**Note:** Prolonged contact with air may cause formation of peroxides that may explode and burst containers; easily undergoes polymerization.]

Exposure Routes, Symptoms, Target Organs (see Table 5):	**First Aid (see Table 6):**
ER: Inh, Ing, Con **SY:** Irrit eyes, nose, throat; eye, skin burns; derm; conj; cough; CNS depres; delayed pulm edema; in animals: kidney, repro, terato effects; [carc] **TO:** Eyes, skin, resp sys, kidneys, CNS, repro sys [in animals: nasal cancer]	**Eye:** Irr immed **Skin:** Water flush prompt **Breath:** Resp support **Swallow:** Medical attention immed

Demeton	**Formula:** $(C_2H_5O)_2PSOC_2H_4SC_2H_5$	**CAS#:** 8065-48-3	**RTECS#:** TF3150000	**IDLH:** 10 mg/m^3
Conversion:	**DOT:**			

Synonyms/Trade Names: O-O-Diethyl-O(and S)-2-(ethylthio)ethyl phosphorothioate mixture, Systox®

Exposure Limits:
NIOSH REL: TWA 0.1 mg/m^3 [skin]
OSHA PEL: TWA 0.1 mg/m^3 [skin]

Measurement Methods (see Table 1):
NIOSH 5514

Physical Description: Amber, oily liquid with a sulfur-like odor. [insecticide]

Chemical & Physical Properties:
MW: 258.3
BP: Decomposes
Sol: 0.01%
Fl.P: 113°F
IP: ?
Sp.Gr: 1.12
VP: 0.0003 mmHg
FRZ: <-13°F
UEL: ?
LEL: ?
Class II Combustible Liquid

Personal Protection/Sanitation (see Table 2):
Skin: Prevent skin contact
Eyes: Prevent eye contact
Wash skin: When contam
Remove: When wet or contam
Change: Daily
Provide: Eyewash
Quick drench

Respirator Recommendations (see Tables 3 and 4):
NIOSH/OSHA
1 mg/m^3: Sa
2.5 mg/m^3: Sa:Cf
5 mg/m^3: SaT:Cf/ScbaF/SaF
10 mg/m^3: Sa:Pd,Pp
§: ScbaF:Pd,Pp/SaF:Pd,Pp:AScba
Escape: GmFOv100/ScbaE

Incompatibilities and Reactivities: Strong oxidizers, alkalis, water

Exposure Routes, Symptoms, Target Organs (see Table 5):
ER: Inh, Abs, Ing, Con
SY: Irrit eyes, skin; miosis, ache eyes, rhin, head; chest tight, wheez, lar spasm, salv, cyan; anor, nau, vomit, abdom cramps, diarr; local sweat; musc fasc, lass, para; dizz, conf, ataxia; convuls, coma; low BP; card irreg
TO: Eyes, skin, resp sys, CVS, CNS, blood chol

First Aid (see Table 6):
Eye: Irr immed
Skin: Soap wash immed
Breath: Resp support
Swallow: Medical attention immed

Review Questions

1. Explain what the equation C x T = Dose means related to the dose response

2. You were exposed to lead over a number of years. Years later you are told that the lead stored in your bones is now being released into your bloodstream. Is this a description of an acute or chronic effect from your chemical exposure?

3. You inhale a chemical from paint you are using and feel dizzy and experience a scratchy throat. Is this a description of acute or chronic effects from your exposure?

4. Which of the four routes of entry is the most common way for a chemical to enter your body?

5. Is the following statement true or false?

   Skin is an organ.

6. Your body can metabolize, store and/or excrete a chemical that you have been exposed to. Explain what the body does in each of these processes.

7. How would you describe a target organ?

8. Is the following statement true or false?

PEL's TLV's, and REL's are legally binding on an employer.

Chapter 4

Hazard Communication

The HasCom is called the right to know standard because employees have both a need and right to know the identities and hazards of the chemicals they are exposed to when working.

Hazard Communication (HazCom) is the communication of chemical hazards to workers.

We have a standard because:

- 32 million workers work with, and are potentially exposed to, one or more chemicals hazards- OSHA
- Over 69 million chemicals are commercially available- CHEMCATS
- Over 600 new chemicals are introduced every year
- Roughly 22% of workplace diseases and injuries are caused by chemicals
- 2011 Report on occupational disease identified 41 known occupational diseases caused by chemical agents

OSHA describes the HCS as largely a performance-orientated standard that gives employers the flexibility to adapt the rule to the needs of the workplace, instead of having to follow specific, ridged requirements. Therefore, there are categories of information to be included in the SDS including physical and chemical characteristics, physical hazards, and applicable precautions and/or measures for handling materials safely.

Employers that don't produce or import chemicals need only focus on those parts of the rule that deal with establishing a workplace program and communicating information to their workers.

Requirements in the HazCom standard

- Written HazCom Program
- Chemical inventory and control
- Hazard classification of chemical
- SDSs available for hazardous substances in the workplace
- Labeling of hazardous chemicals
- Training workers
- Makes required information available

A new addition to the HazCom standard is the Globally Harmonized System. The original standard aimed to give workers the "right to know' but the new system aims to give the workers the "right to understand".

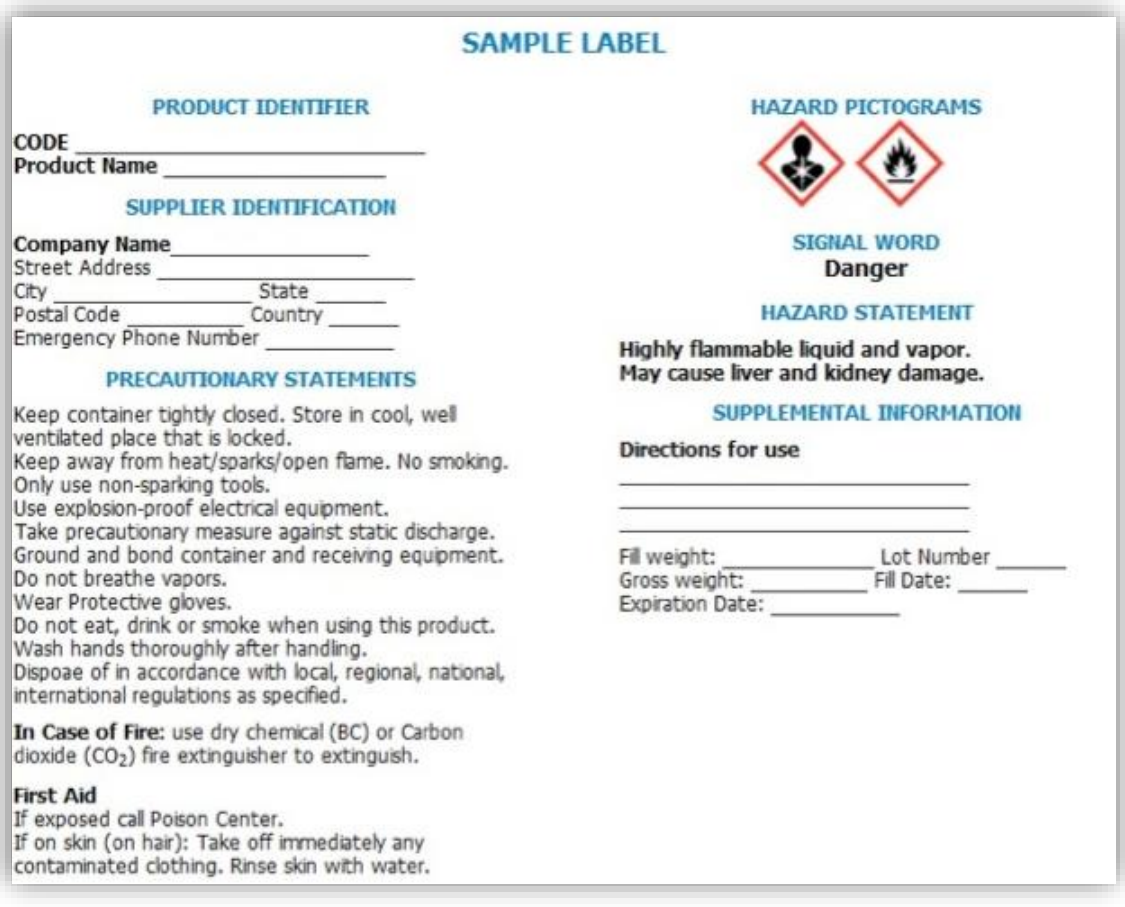
Benefits of the new standard:

- Enhanced worker comprehension of hazards, especially for low and limited-literacy workers
- Provide workers quicker and more efficient access to information on the safety data sheets
- Reduce trade barriers by harmonizing with systems around the world

Major changes

- Hazard classification: Chemical manufacturers and importers are required to determine the hazard of the chemicals they produce or import
- Labels: Chemical manufacturers and importers must provide a label that includes a signal word (DANGER or WARNING) , pictogram, hazard statement, and precautionary statement for each hazard class and category
- Safety Date Sheets: The new format requires 16 specific sections, ensuring consistency
- Information and training: To facilitate understanding of the new system, the new standard
- requires that workers be trained on the changes

Hazard Communication Label Example



SAMPLE LABEL

PRODUCT IDENTIFIER

CODE _____
Product Name _____

SUPPLIER IDENTIFICATION

Company Name_____
Street Address _____
City _____ State _____
Postal Code _____ Country _____
Emergency Phone Number _____

PRECAUTIONARY STATEMENTS

Keep container tightly closed. Store in cool, well ventilated place that is locked.
Keep away from heat/sparks/open flame. No smoking.
Only use non-sparking tools.
Use explosion-proof electrical equipment.
Take precautionary measure against static discharge.
Ground and bond container and receiving equipment.
Do not breathe vapors.
Wear Protective gloves.
Do not eat, drink or smoke when using this product.
Wash hands thoroughly after handling.
Dispoae of in accordance with local, regional, national, international regulations as specified.

In Case of Fire: use dry chemical (BC) or Carbon dioxide (CO_2) fire extinguisher to extinguish.

First Aid
If exposed call Poison Center.
If on skin (on hair): Take off immediately any contaminated clothing. Rinse skin with water.

HAZARD PICTOGRAMS

SIGNAL WORD
Danger

HAZARD STATEMENT

Highly flammable liquid and vapor.
May cause liver and kidney damage.

SUPPLEMENTAL INFORMATION

Directions for use

_____
_____
_____

Fill weight: _____ Lot Number _____
Gross weight: _____ Fill Date: _____
Expiration Date: _____

Health Hazard

- Carcinogen
- Mutagenicity
- Reproductive Toxicity
- Respiratory Sensitizer
- Target Organ Toxicity
- Aspiration Toxicity

Health Hazard chemicals pose a risk to your health if used improperly.

Flame

- Flammables
- Pyrophorics
- Self-Heating
- Emits Flammable Gas
- Self-Reactives
- Organic Peroxides

The Flame pictogram indicates there is a fire risk, and you should be especially concerned about ignition sources and combustible materials.

Exclamation Mark

- Irritant (skin and eye)
- Skin Sensitizer
- Acute Toxicity
- Narcotic Effects
- Respiratory Tract Irritant
- Hazardous to Ozone Layer (Non-Mandatory)

Gas Cylinder

Gases Under Pressure

The Gas Cylinder pictogram alerts you to the physical hazards inherent in the use and storage of compressed gas.

Corrosion

- Skin Corrosion/Burns
- Eye Damage
- Corrosive to Metals

The Corrosion label should prompt you to be especially aware of PPE and storage requirements.

Exploding Bomb

- Explosives
- Self-Reactives
- Organic Peroxides

Chemicals marked with an Exploding Bomb pose a significant physical risk and should be treated with extreme caution.

Flame Over Circle

- Oxidizers

Chemicals labeled with a Flame over Circle can create an increased fire risk in your work or storage environment.

Skull and Crossbones

- Acute Toxicity (fatal or toxic)

The Skull and Crossbones pictogram will usually be used in combination with a Health Hazard pictogram to signify particularly hazardous chemicals.

Chemicals with Acute Toxicity (fatal or toxic) are chemicals that will produce adverse effects following a single dose of the substance. These effects are more serious than the Acute Toxicity (harmful) listed under the Exclamation Point pictogram

Safety Data Sheets

Section 1: Identification

- Common names or synonyms
- Name, address, phone numbers of manufacturer or importer
- Recommended use of the chemical and any restrictions on use

Section 2: Hazard Identification

- Hazard classification of the chemical
- Signal word
- Hazard statement
- Pictograms
- Precautionary statements
- Description of any hazards

Section 3 Composition or Ingredients

- Identification of ingredients
- Chemical names
- Common names and synonyms

- Chemical Abstract Services
- Impurities and stabilizing additive
- Mixtures

Section 4: First Aid Measures

- Initial care
- Necessary first-aid instructions
- Important symptoms or effects of any symptoms
- Recommendations for immediate medical care

Section 5: Fire Fighting Measures

- Recommendations of suitable extinguishing equipment
- Advice on specific hazards that develop from the chemicals during the fire
- Any special protective equipment or precautions for firefighters

Section 6: Accidental Release Measures

- Appropriate response to spills, leaks, or releases, including containment and cleanup
- Emergency Procedures, including instructions for evacuations
- Use of personal precautions and protective equipment
- Cleanup procedures

Section 7: Handling and Storage

- Guidance on the safe handling practices for safe storage of chemicals
- Precautions for safe handling, incompatible chemicals, hygiene practices
- Safe storage and incompatibilities

Section 8: Exposure Controls/PPE

- OSHA PEL's and any other recommendations or limits
- Appropriate engineering controls
- Recommendations for any personal protective measures such as PPE
- Any special PPE such as type of gloves and breakthrough time

Section 9: Physical and Chemical Properties

This section identified physical and chemical properties with the substance or mixture. Below are a few

- Odor
- Flash points
- Flammability
- Upper/lower flammability limits
- Vapor density

Section 10: Stability and Reactivity

- Reactivity hazards

- Chemical stability

Section 11: Toxicological Information

- Routes of exposure
- Description of delayed, immediate, or chronic effects
- Measure of toxicity
- Description of symptoms

Section 12: Ecological Information

- Data of effects on environment and wildlife
- Results on test of soil and ground water

Section 13: Disposal Considerations (non-mandatory)

This section gives guidance on proper disposal practices, recycling or reclamation of the chemical and safe handling practices

Section 14: Transport Information

This section provides guidance on classification information for shipping and transporting of hazardous chemical(s) by road, air, rail, or sea.

Section 15: Regulatory Information (non-mandatory)

- Information not otherwise given

Section 16: Other Information

- Date when SDS was prepared or updated

Chapter 5

Monitoring and Instrumentation

Workplace Monitoring

This is the process of collecting, detecting and measuring the jobsite for chemical, physical, and biological hazards.

The monitoring is important for knowing what hazards are at your jobsite, how serious they are and what should be done to ensure your safety.

The reasons for site monitoring:

- Identify hazards
- Evaluate the effectiveness of engineering controls and work practice
- Assess worker exposure to chemical, physical, and biological hazards
- Determine compliance with occupational and environmental regulations
- Locate and evaluate potential sources of contamination, such as poor work practices or faulty engineering controls

Monitoring is required in certain situations:

- During initial entry when the site evaluation shows the potential for ionizing radiation or immediately dangerous to life and health
- When chemical exposures are above permissible exposure limits (PEL) set by OSHA or state plans
- When airborne concentrations of contaminates are suspected to exceed the protection factors of the PPE in use
- When flammable or oxygen-deficient environments are suspected
- During emergency response

Types of Hazards

- **Toxic chemicals**- These chemicals are characterized by the presence of vapors, gasses, and aerosols that can endanger health
- **Oxygen deficiency**- An atmosphere containing less than 19.5 percent oxygen requires breathing apparatus before entry
- **Flammable atmospheres**- The presence of ignitable or explosive vapors, gases, aerosols, or dusts presents a real danger
- **Corrosive chemicals**- These materials cause severe irritation or even destruction when they contact human tissue
- **Total and respirable dust**- These are inert materials suspended in air which can be inhaled
- **Noise**- Exposure to high levels of noise can damage your ears and cause hearing loss
- **Temperature extremes**- Both hot and cold temperatures can put extreme stress on the body
- **Ionizing radiation**- High energy in the form of waves or particles has the ability to cause cellular damage

Air Monitoring

Airborne chemicals pose one of the biggest dangers to your health on the jobsite. Problem is that they are unseen but can harm you and be deadly.

Effective air monitoring tells you what contaminates are present at a site and in what concentrations. It starts during the site characterization process and continues through the length of the job.

Reasons for air monitoring:

- **Selecting PPE**- The more toxic or concentrated the contaminate, the higher the level of protection is needed. This can range from a 1/2 mask to a SCBA
- **Determining where protection is needed**- It is possible that level of protection can change based on the individual location of the site.
- **Analyzing health effects**- Awareness of contaminates present allows those in charge to know what health hazards each contaminate brings
- **Determining medical monitoring**- When hazards are known, medical personnel can monitor your health specifically for the presence of those contaminates
- **Selecting and maintaining control zones**- The jobsite can be segregated properly according to the airborne hazards present in various locations
- **Monitoring Phases**-Monitoring begins when the site is first being analyzed, and continues through the end of the job

Site monitoring is not unlike Confined Space monitoring which has two phases:

- Pre-entry testing
- Periodic and/or continuous monitoring

Pre-entry Testing

1. **Oxygen level testing**- Oxygen levels must be at least 19.5 percent by volume to enter the site without an atmosphere supplying respirator
2. **Explosive atmosphere test**- If oxygen levels are higher than normal or the air is between lower (LEL) or upper explosives limits (UEL), the air may be more prone to explosion or flammability
3. **Toxic air contaminates test**- Different instruments monitor for any toxic contaminates present

Periodic Testing and Continuous Monitoring

Conditions change at a worksite. Safety plans require monitoring to be done on a periodic schedule. Here are some typical reasons for performing periodic monitoring:

- Work begins at a different part of the site
- Different contaminants are being handled
- A different type of operation is started
- Workers are handling leaking drums or working in areas with an obvious liquid contamination
- Spills or lagoons are encountered

- The work being performed may create a hazardous atmosphere

Personal Monitoring

Work such as Asbestos, lead or silica exposure may require personnel monitoring. Concrete cutting puts a worker in a situation where contaminates will enter the breathing zone.

OSHA says in its Technical manual that "personal monitoring is the gold standard" for determining employee exposure.

Instrumentation

There are two major approaches for identifying or measuring chemical or physical

and biological hazards:

- **Direct reading instruments**
- **Laboratory analysis**

Each of these approaches has pros and cons, and each works best for testing certain hazards.

Direct Reading Instruments

Direct reading instruments were developed as early warning devices. These instruments give an instant readout to let you know about any dangers present. Some instruments are so refined they can detect contaminants in concentrations below one part per million.

Typically trained technicians handle monitoring activities at the jobsite. You still may be required to wear observe or use direct reading instruments.

Limitations

Direct reading instruments are limited in some areas:

- They usually detect and /or measure only specific classes of chemicals
- They might detect more than one substance, thus giving false readings
- Weather conditions such as temperature, wind, rain fall and humidity might affect their accuracy
- They may not be calibrated correctly
- Their detection may be limited

Proper operation

- Read manual
- Check the batteries
- Proper start up procedures
- Clean and maintain the instrument regularly

Calibration and Checks

When direct reading instruments sample and analyze an unknown atmosphere, they internally compare it to a known reference gas, called a calibration gas.

Detection Range

Direct read instruments are designed to detect specific hazards within a certain range or concentration. An instrument that can only detect ppm may not be affective for chemicals that have hazards at ppb.

Response Time

An instrument's response time can be affected by several factors:

- Length of sample hose
- Flow rate of pump
- Instrument's response time (i.e. does the detector have a pump or does it have bypass sensors.)
- Contaminants- other contaminants may slow the instrument's response time
- Safety-Most direct read instruments use electronic circuitry. That means they can be a source of ignition
- Interference- An example is leaded gasoline can permanently damage the filaments in a combustible gas detector or carbon dioxide poisons the cell in an oxygen meter
- Environmental- Temperature, humidity, and barometric pressure can affect an instrument. An example is a photoionization detector has difficulty reading some gasses and vapors in high humidity

Fixed Monitoring Equipment

Fixed monitoring equipment warn if abnormal or hazardous conditions develop. Basically, an early warning detection system. Some common types are:

- Toxic gas monitors
- Area and airborne radiation monitors
- Combustion gas and oxygen monitors
- Carbon Monoxide detectors
- Fire or Smoke detectors

Portable Direct Reding Instruments

Some examples of some of the more common types of portable instruments:

- Combustible gas and oxygen indicator
- Flame ionization detector
- Photoionization detector
- Detector tube
- Sound level meter
- Radiation detector

Four Gas detector

Probably one of the most important direct reading instruments. The first step is pre-entry testing. Most have two alarms based on the level of the contaminate that are adjustable.

Advantage of the four-gas detector is its ease of use. Below is a list of Features and Limitations:

Features	**Limitations**
Measures oxygen concentrations and combustible gas concentrations as a percentage of the lower explosive limit (LEL)	Potential interference from leaded gas and silicates
Lightweight and portable	Most models do not measure specific gasses
Visible and audio alarm	May not function in atmospheres with less than 10% oxygen
Probes and sample lines for remote applications	High humidity may interfere with the oxygen cell
8-12 hours of battery life	A strong oxidizer may cause an artificially high oxygen readout
Accurate to 2 to 3 %	

Flame Ionization Detector

This instrument is best for contaminates such as carbon, toluene and benzene. This device would be helpful in determining what respiratory protection would be needed.

Features	**Limitations**
Measures the total concentration of an organic material in the air	Should not be used in temperatures less than 40^0 F
Lightweight and portable	Modifications required in oxygen-deficient and high-concentration atmospheres
8 hour battery life	Does not detect inorganic gasses and vapors
Reads from 0 to 1000 ppm	Requires experience to operated and interpret data

Photoionization Detector (PID)

This device detects many organic gases and vapors as well as a few inorganic ones. The PID is factory calibrated to benzene and will respond to benzene concentrations as low as .2 ppm. Advantages over the FID: Easier to use, cost less and has a faster response time.

Features	Limitations
Measures the total concentration of an organic and inorganic material in the air	Does not detect methane
Lightweight, portable and fairly easy to operate	Must have correct probes to detect certain compounds
10 hour battery life	Does not identify individual components
Reads from 0 to 2000 ppm	

Detector Tubes (Drager Tube)

A colorimetric detector tube is a glass vial containing a chemical that reacts with the contaminate being monitored. There are many tubes for testing a variety of compounds. A hand drawn pump draws a measurable amount of air through the tube and the reaction changes the color on the tube which corresponds to a scale on the glass tube.

Features	Limitations
Measures both volatile organic and inorganic material in the air	Low accuracy of $\pm$ 25%
Lightweight and portable	Requires previous knowledge of gasses and vapors in order to select the appropriate tube
Simple and easy to use- no battery	Some chemicals will react with the tube and cause a false positive
Reads ppb and ppm	Temperature and humidity may affect readings

Sound Level Meter

When noise levels are at or above 85 dB, noise monitoring is required, and in Washington State, hearing protection required. The reason noise levels are important at a clean up site are due to the importance of maintaining a good level of communication in addition to protecting your hearing. It is best to control the noise levels at the source than to require hearing protection form the workers.

Radiation Detector

By far the most popular is the Geiger counter. It detects ionizing radiation, usually gamma and beta radiation. Typically the only time this device is used is on sites where cleanup operations involve a radioactive dispersal device was detonated.

Laboratory Analysis

Some contaminates can only be sampled by laboratory analysis.

Features	**Limitations**
More accurate for low contaminate amounts	Takes time to analyze
Track multiple contaminates	Cannot detect IDLH in time
Can analyze Asbestos, lead, silica	Does not give instantaneous readings only TWA
Can measure TWA	
Not affected by temperature or moisture	

Group Discussion Activity

As a group, discuss what instrument would be best for the following conditions.

1. An unknow liquid appears on the floor at a hazardous waste cleanup site

2. Permanent machinery exhaust carbon monoxide into a work area

3. Several people in the neighboring community who live next to a chemical processing plant have reported getting sick and having breathing difficulties.

4. Workers report a natural gas odor in a specific area.

5. Workers are cutting up a concrete slab.

6. Entry into a confined space is required.

Chapter 6

Medical Surveillance

A medical surveillance program is required when:

- Workers are exposed or potentially exposed to hazardous wastes or health hazards above OSHA's PEL for 30 or more days a year.
- Workers wear approved respirators for 30 or more days per year.
- Workers not wearing appropriate PPE are exposed to accidental or emergency releases of hazardous wastes above exposure limits.
- Workers show symptoms of an illness that may have started from exposure to hazardous substances.
- Workers are members of a HAZMAT team.

A medical surveillance program must be in place for each workplace where there is potential for exposure causing a health risk. This includes a medical exam before employment, move to a new job or different site.

Provisions for medical surveillance program:

- Examination done by a licensed physician paid by employer
- Most are annually or every two years if approved by physician
- Medical and work history included in exam
- Worker found "fit for duty"
- Additional exams performed if injured or become ill
- Employer receives report but no private information

Medical Surveillance program requires the following from your employer:

- A copy of the OSHA standard specific to the workplace
- A description of your duties as they relate to the hazard
- Estimated exposure level
- Description of PPE used to include respiratory
- Any additional previous medical exams (if possible)
- Only you and the physician are allowed to see any private information

Recordkeeping:

- Keep exposure records for 30 years
- Keep medical records for the length of employment plus 30 years
- Provide the records to the employee upon termination of employment
- Advise the worker of the location and availability of records
- Notify NIOSH if company stops doing business

Medical Surveillance Program

Read the following and discuss them in a group:

A friend of yours at the aluminum plant you both work at has been very moody lately, and you know something is bothering him. He finally tells you that he has not been feeling very well for quite a while. He feels depressed and irritable all the time and knows that it hasn't helped with the trouble he is having at home- he and his wife are always fighting because she says he is too moody. Also, they have been trying to have a child, and his wife is going for fertility testing, but so far nothing has worked.

You convince him to go to the doctor for a checkup, and when the doctor hears his symptoms, he orders a blood lead level. It is 52 mcg/dl- an above normal result. The doctor tries to find out the last lead measurement for comparison and finds out your friend never had a test for lead levels.

1. What OSHA regulations have been violated in this scenario?

2. Why should your friend have known that his symptoms were being caused by high lead levels?

3. Your friend did not want to go to the doctor at first. He was treated for an embarrassing contagious disease last year and didn't want that report to get back to the company office. Why doesn't he have to worry about that?

4. What's wrong with these statements?

a. Annual physical examinations can be done by the company nurse.

b. You are responsible for going to your family doctor and paying for the physical if you want to keep your medical records private.

c. You should have a new physical examination only if your work-related symptoms become worse.

d. Even if you are found unfit for duty, you may still have to work if no replacement is available on the job.

e. You must basically forfeit your HIPAA privacy rights for medical surveillance benefits.

f. You should find a doctor just for work-related sicknesses so that your family doctor doesn't have to report all your possibly embarrassing medical issues on the report the doctor files for medical surveillance.

g. Your annual physical exam report is all that is needed as long as you stay on the same site.

- You cannot access your medical records without proper authorization and representation.

Chapter 7

Respiratory Protection

Dates back to 23 AD when animal bladders were used to protect from lead oxide in Roman mines. The First "gas masks" were developed for the military in response to chemical warfare to protect against chlorine, phosgene and mustard gas.

Fire services has had a great influence on the development of respiratory protection especially SCBA

Before 1970, the use of respirators was generally advisory rather than mandatory. Current standards were adopted in 1998 and include selection, use, training fit-testing and certification. One important standard is that "Respirators are not the preferred means of protecting employees"

1. Written program
2. Selection base on hazards involved
3. Operator training
4. Reserved (?)
5. Cleaning and disinfection of respirators
6. Storage of respirators
7. Inspection and maintenance of respirators
8. Surveillance of worker exposures
9. Regular evaluation of respirator program
10. Medical evaluation of respirator users
11. Use of approved respirators

OSHA's general policy on respirator use:

- Where engineering or administrative controls are not feasible or insufficient
- During the time when engineering or administrative controls are being implemented
- For emergency response situations

Filters can remove dusts, mists, fumes, others .5 to 5 microns*. Cannot protect against gases, vapors, or low O2. Removal mechanisms:

Interception	sedimentation
Impaction	diffusion
electrostatic attraction	

* Human hair is 50 microns

3 levels of filter efficiency:

95%	(called "95")
99%	(called "99")
99.97%	(called "100")

3 categories of resistance to filter efficiency degradation:

N (Not resistant to oil)

R (Resistant to oil)

P (oil Proof)

If no oil particles are present in the work environment, use a filter of any series. If oil particles are present, use an R- or P-series filter. If oil particles are present and the filter is to be used for more than one work shift, use only a P-series filter.

Selection of filter efficiency depends on how much filter leakage can be accepted. Choice of facepiece depends on level of protection needed (APF).

Type of Respirator	Half Mask	Full Facepiece	Helmet/Hood
Air purifying	10	50	
• Powered air purifying (PAPR)	50	1000	25/1000
Supplied air • Demand • Continuous flow • Pressure Demand	 10 50 50	 50 1000 1000	25/1000
Self-contained breathing apparatus • Demand mode • Pressure demand	10	50 10,000	50 10,000

PPE Level	Summary	Protection Required Helmet/Hood
A	Highest level of skin, eye and respiratory protection.	Totally encapsulating Chemical Protective Clothing
B	Highest level of respiratory protection and appropriate level of skin determined by type and concentration of substance	CPC suite, SCBA, or SAR-E
C	Appropriate atmosphere-supplied respiratory protection and the appropriate level of skin protection.	CPC suit, APR, PAPR, or SAR
D	The atmosphere contains no known hazards	No respiratory pro-tection and minimal skin protection

Atmosphere Contaminate	Color Assigned
Acid Gas	White
Hydrocyanic acid gas	White with 1/2 –inch green stripe completely around
Chlorine vapors	White with ½-inch yellow stripe
Organic vapors	Black
Ammonia gas	Green
Acid gases and ammonia gasses	Green with ½-inch white stripe
Carbon monoxide	Blue
Acid gases and organic vapors	Yellow
Radioactive materials	Purple (Magenta)
Dust (asbestos, lead, silica)	Purple (Magenta)

Service life of cartridges or canisters depends on:

- quality and amount of sorbent
- packing uniformity and density
- exposure conditions, breathing rate
- relative humidity
- temperature
- contaminant concentration
- affinity of the gas or vapor for the sorbent

- presence of other gases and vapors

Adequate warning properties

NIOSH permits air purifying respirators only if the contaminant has adequate warning properties: reliable detection of the contaminant below the PEL by user's sense of smell, taste, or irritation only applies to gases and vapors -- not particulate Exception is if AP element has an ESLI. Remember that odor thresholds vary substantially from one individual to another

OSHA: respirator cartridge changeout based on odors or taste unacceptable

Self-contained breathing apparatus

Open-circuit type
- bottled air from 2000 to 4500 psi typically
- time from 15 min to 60 min typically
- demand or pressure demand or continuous flow
- can be combined with supplied air respirator
- escape-only type available in 5, 7, 10 or 15 minute size

Closed-circuit type (also called re-breathers)
- could be either negative or positive pressure type
- possible to "over breathe"
- more complicated to maintain
- requires more training
- longer use period ... sometimes up to 4 hours

Qualitative fit testing (QLFTs)
- isoamyl acetate (IAA)
- irritant smoke (usually titanium and stannic chloride)
- saccharin aerosol (taste test)
- denatonium benzoate (Bitrex)
- must verify wearer can respond
- wearer must be truthful

Quantitative fit testing
- dioctyl phthalate aerosol
- corn oil
- sodium chloride
- DEHS
- ambient air (with submicron particulate counting)
- ambient air (pressure differential)

Other things …
- No facial hair that can interfere with seal
- User seal test

- Cannot base cartridge change-outs on odor, smell or taste
- Seal check whenever donning respirator
- In IDLH areas, must have standby outside equipped and trained for rescuing
- Structural firefighting: 2 in and 2 out (buddy system)

Fit testing:
- Qualitative or quantitative methods used for tight-fitting respirators
- Must be re-fitted when respirator changed and annually
- Qualitative can only be used with fit factors of less than 50; quantitative required when FF > 50
- Must use methods in Appendix A
- Atmosphere-supplying respirator must be tested when in negative pressure mode

Exposure Assessment
- Identify airborne contaminants where possible
- Match up specifications and limitations of respirators
- Consider abnormal conditions that may cause concentrations to rise
- Think in terms of "worst case" exposures
- Apply substance-specific requirements
- Communicate information to employees; discuss signs, symptoms of overexposure
- Keep good records

Non-routine use of respirators
Three situations require careful consideration:
- entry into confined spaces
- entry into oxygen-deficient atmospheres
- emergencies

NIOSH: IDLH based on two factors:
- worker must be able to escape within 30 min without losing life or suffering permanent health damage, and
- worker must be able to escape without severe eye or respiratory irritation or other reactions that could inhibit escape

IDLH atmospheres -- Only 2 types allowed:
- SCBA in pressure-demand mode (>15 minute air supply)
- Type C airline respirator, pressure-demand or continuous flow mode, with auxiliary escape bottle (minimum service life of 3 minutes)

IDLH atmospheres (low oxygen)
- Can use demand (negative pressure) airline respirator

OSHA Respirator Standard

- Use engineering controls where feasible
- Employer supplies respirators and establishes a program
- Program must be written with work-site specific procedures and elements for required respirator use
- Program must have an administrator
- Medical evaluations
- Fit testing for tight-fitting respirators
- New procedures where respirator is worn voluntarily
- Appropriate selection of respirators - NIOSH certification and within certification limits
- Evaluate exposures - assume IDLH if unable to evaluate
- Selection to include sufficient number…to get a good fit
- Change-out of cartridges - ESLI or "objective data"

Medical evaluations:

- PLHCP
- Screening questionnaire
- Follow-up examination if any positive answers
- Supply PLHCP with respirator info, work conditions, other PPE, duration and frequency or respirator use, copy of written program and OSHA standard
- Must supply PAPR if negative pressure respirator is unacceptable

Additional Medical evaluations required when:

- Report of related medical signs or symptoms
- PLHCP, supervisor or program administrator informs the employer that a reevaluation is needed
- Information from program, fit-testing suggest need for reevaluation
- Change in workplace increases physiological burden on worker

Chapter 8

Personal Protective Equipment

Employers must protect employees from hazards such as falling objects, harmful substances, and noise exposures that can cause injury

- Employers must:
  - Use all feasible engineering and work practice controls to eliminate and reduce hazards.
  - Use personal protective equipment (PPE) if the controls don't eliminate the hazards.
- PPE is the last level of control!
- It is possible to over protect worker.

If the work environment can be physically changed to prevent employee exposure to the potential hazard, then the hazard can be eliminated with an engineering control

Examples:

- Initial design specifications
- Substitute less harmful material
- Change process
- Enclose process
- Isolate process

If employees can change the way they do their jobs and the exposure to the potential hazard is removed, then the hazard can be eliminated with a work practice control.

Examples:

- Job rotation
- Wet method
- Personal hygiene
- Housekeeping and maintenance

Employer

- Assess workplace for hazards
- Provide PPE
- Determine when to use
- Provide PPE training for employees and instruction in proper use

Employee

- Use PPE in accordance with training received and other instructions
- Inspect daily and maintain in a clean and reliable condition
- Bring to attention any problems or issues with PPE

Program
Includes procedures for selecting, providing and using PPE

First -- assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of PPE.
After selecting PPE, provide training to employees who are required to use it

A well ran program protects the worker from safety and health hazards and protects worker from incorrect use or malfunction of the PPE

Program is reviewed every year. Review includes:

- Survey of each site
- Accident and illness experiences,
- Training and recordkeeping

Training includes:

- Why it is necessary
- How it will protect them
- What are its limitations
- When and how to wear
- How to identify signs of wear
- How to clean and disinfect
- What is its useful life & how is it disposed

Head Protection

- Falling objects such as tools
- Bumping head against objects, such as pipes or beams
- Contact with exposed electrical wiring or components

Types

- Class A-General service (building construction, shipbuilding, lumbering). Good impact protection but limited voltage protection
- Class B-Electrical / Utility work. Protects against falling objects and high-voltage shock and burns
- Class C-Designed for comfort, offers limited protection. Protects against bumps from fixed objects, but does not protect against falling objects or electrical shock

Eye Protection

- Dust and other flying particles, such as metal shavings or sawdust
- Corrosive gases, vapors, and liquids
- Molten metal that may splash
- Potentially infectious materials such as blood or hazardous liquid chemicals that may splash
- Intense light from welding and lasers

Criteria for eyewear

- Protects against specific hazard(s) (i.e. dust, liquid, vapor)
- Comfortable to wear

- Does not restrict vision or movement
- Durable and easy to clean and disinfect
    - Does not interfere with the function of another required PPE

Ordinary glasses do not provide the required protection. Proper choices include:
- ANSI Z87 Prescription glasses with side shields and protective lenses
- Goggles that fit comfortably over corrective glasses without disturbing the glasses
- Goggles that incorporate corrective lenses mounted behind protective lenses
- Most operations require at a minimum, safety glasses with side shields and are used for moderate impact from particles produced by jobs such as carpentry, woodworking, grinding, and scaling
- Laser and welding requires more protection

Hearing Protection

The table below shows noise levels and how long a person can be exposed without hearing protection before there is damage to the ear.

Noise Level	Allowable Exposure Time
85 decibels	8 hours
90 decibels	4 hours
100 decibels	1 hour
105 decibels	30 minutes
110 decibels	15 minutes
115 decibels	0 minutes

Hearing Protection must be worn:
- After implementing engineering and work practice controls and the noise level cannot be reduced below applicable noise standard
- When an employee's noise exposure exceeds an 8-hour time-weighted average (TWA) sound level of 85 dBA

In addition, annual hearing test must be conducted if 8hr exposure last more than 30 days

Foot Protection when any of these are present:
- Heavy objects such as barrels or tools that might roll onto or fall on employees' feet
- Sharp objects such as nails or spikes that might pierce ordinary shoes
- Molten metal that might splash on feet
- Hot or wet surfaces
- Slippery surfaces
- Impact-resistant toes and heat-resistant soles protect against hot surfaces common in roofing and paving
- Some have metal insoles to protect against puncture wounds
- May be electrically conductive for use in explosive atmospheres, or nonconductive to protect from workplace electrical hazards

Hand Protection

Hazards

- Burns
- Bruises
- Abrasions
- Cuts
- Punctures
- Fractures
- Amputations
- Chemical Exposures
    - Nitrile protects against solvents, harsh chemicals, fats and petroleum products and also provides excellent resistance to cuts and abrasions.
    - Butyl provides the highest permeation resistance to gas or water vapors
    - Kevlar protects against cuts, slashes, and abrasion
    - Stainless steel mesh protects against cuts and lacerations

Chemical Resistance of Gloves – Quick guide

Nitrile gloves:

- Acetone - fair
- Ethanol - excellent
- Isobutyl - alcohol excellent
- Isopropyl - alcohol excellent
- Methanol - fair

Latex gloves:

- Acetone - good
- Ethanol - excellent
- Isobutyl - alcohol poor
- Isopropyl - alcohol excellent
- Methanol - fair

PVC gloves:

- Acetone - poor
- Ethanol - excellent
- Isopropyl alcohol - good
- Methanol - good

Viton gloves & Butyl gloves:

- Acetone good

Body Protection

Major injuries

- Intense heat
- Splashes of hot metals and other hot liquids
- Impacts from tools, machinery, and materials
- Cuts
- Hazardous chemicals
- Radiation

Types of body protection:
- Vests
- Aprons
- Jackets
- Coveralls
- Full body suits

Level A- Use level A for 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.
- Positive pressure, full face-piece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA, approved by NIOSH.
- Totally-encapsulating chemical-protective suit.
- Gloves, outer, chemical-resistant.
- Gloves, inner, chemical-resistant.
- Boots, chemical-resistant, steel toe and shank.
- Hard hat (under suit as required)
- Disposable protective suit, gloves and boots (depending on suit construction, may be worn over totally-encapsulating suit).

Level B- When the type and atmospheric concentration of substances have been identified and require a high level of respiratory protection, but less skin protection. The atmosphere contains less than 19.5 percent oxygen; or 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.
- Positive pressure, full-facepiece self-contained breathing apparatus (SCBA), or positive pressure supplied air respirator with escape SCBA (NIOSH approved)
- Hooded chemical-resistant clothing (overalls and long-sleeved jacket; coveralls; one or two-piece chemical-splash suit; disposable chemical-resistant overalls)
- Gloves, outer, chemical-resistant
- Gloves, inner, chemical-resistant
- Boots chemical-resistant steel toe and shank.
- Hard hat (as needed)

Level C- The atmospheric contaminants, liquid splashes, or other direct contact will not adversely affect or be absorbed through any exposed skin; The types of air contaminants have been identified, concentrations measured, and an air-purifying respirator is available that can remove the contaminants; and all criteria for the use of air-purifying respirators are met.

- Full-face or half-mask, air purifying respirators (NIOSH approved)
- Hooded chemical-resistant clothing (overalls; two-piece chemical-splash suit; disposable chemical-resistant overalls)
- Gloves, outer, chemical-resistant
- Gloves, inner, chemical-resistant
- Boots, chemical-resistant steel toe and shank
- Hard hat.(as needed)

Level D- The atmosphere contains no known hazard; and work functions preclude splashes, immersion, or the potential for unexpected inhalation of or contact with hazardous levels of any chemicals.

- Coveralls
- Gloves (optional)
- Boots/shoes, chemical-resistant steel toe and shank
- Safety glasses or chemical splash goggles (as needed)
- Hard hat (as needed)

Selection of Chemical Protective Suits (clothing) (CPC)

Choosing the right chemical protective clothing for a particular job is complex. The most appropriate clothing will depend on the chemical exposure at the jobsite. There are three considerations for choosing the right protection, **permeation, degradation, and penetration**.

Permeation happens when a chemical dissolves and passes through material. Even though CPC provides a barrier, some chemicals can eventually work their way through.

Degradation is when fabric loses ifs effectiveness as a barrier because chemicals have broken it down. Evidences are when the material is puckered, brittle or eroded sunlight and high temperature can also cause degradation.

Penetration is when chemicals pass through zippers, stitched seams, pinholes or other openings in the material.

Factors that affect the rate of permeation, degradation, and penetration are:

- Contact time
- Concentration
- Temperature
- Size of containment material and
- Physical state of the wastes (i.e. mixed chemicals)

Other considerations are heat transfer, durability, flexibility, ease of decontamination, compatibility, and duration of use.

PPE Review Questions

1. Cite at least two drawbacks to overprotecting yourself with more PPE than is needed for the hazard:

2. What is the most common route for chemicals to get into your body?

3. State a second route of chemical exposure:

4. Match the following terms to their definitions:

- Permeation When a chemical passes through various openings in the materials.
- Degradation When a chemical dissolves and passes through the materials.
- Penetration When chemicals break down the fabric so it is less effective as a barrier.

5. What is the difference between level A and level B ensembles in the protection provided?

6. Is the following statement true or false? "The level of PPE you wear is determined by the respiratory protection needed." T or F

7. What is the minimum level of protection you would wear in a situation having unknown conditions?

8. Which ensemble level(s) does not use a respirator?

9. List nine factors that must be considered to ensure the proper use of PPE:

10. Is the following statement true or false? “All workers, even those not wearing protective equipment, should be monitored for heat stress.” T or F

11. List three monitoring measurements used to detect heat stress:

12. What steps would you include if you were to construct a plan to prevent heat stress?

Chapter 9

Decontamination

Importance of Decontamination

There is no doubt that during your work life you will work around chemicals. Many of them will be hazardous. Even at home, there are hazardous chemicals used.

Decontamination is the process of removing or neutralizing contaminates that have collected on you or your PPE and your tools or equipment. Without proper decontamination all kinds of potential exposure may be possible. Some of the ways you can be expose to hazardous chemicals are:

- Saturation of PPE that causes direct exposure to your skin
- Exposure when PPE is improperly removed
- Contaminated tools used by unprotected workers
- Loved ones exposed due to improper decontamination (i.e. dirty clothes in vehicle)
- Contaminated materials transferred to a clean area
- incompatible chemicals mixed

Contamination Prevention

Contamination occurs when a hazardous material is spread to an unwanted location.

Avoidance

Good planning is the best preventative method to effectively prevent contamination. This includes a SOP (Standard Operating Procedure). The following are some examples:

- Use remote methods when sampling or handling. Example is use tongs when handling used needles.
- Use plastic bags or sheeting to protect your tools
- Wear PPE **properly** to gain maximum protection
- Wear a layer of protection (such as Tyvek®) on top of PPE
- Good communication
- Don't touch barrels, equipment, or debris unless required to
- Don't sit or set items on potentially contaminated surfaces or ground

Contaminate Transfer

This type of contamination occurs when an item or person passes to another item or person. The following are some SOP's

- Take off your various levels of personal protective equipment with care
- Assume equipment is still contaminated even though it has been washed
- Avoid touching others on their inner clothing or skin

Decontamination Plan

- The specific hazardous material at the site
- Number and layout of decontamination stations
- Equipment needed

- Appropriate methods for decontamination
- Procedures to prevent contamination of clean areas
- Methods and procedures to reduce your contact with contaminates when removing PPE
- Methods for disposing of clothing and equipment that are not completely decontaminated

Methods of Decontamination

Physical Removal

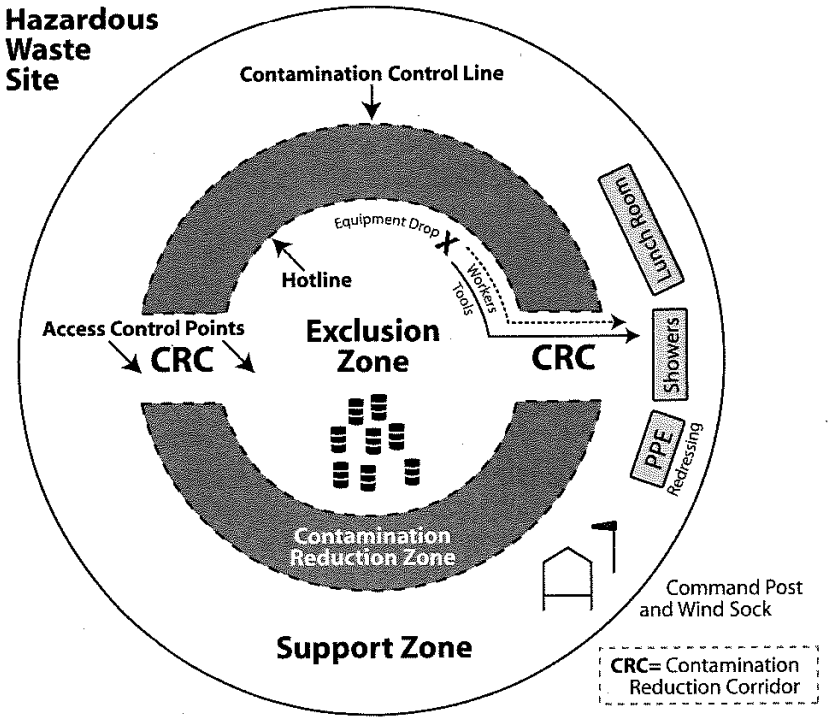
- Scraping
- Brushing
- Wiping
- Rinsing
- evaporating

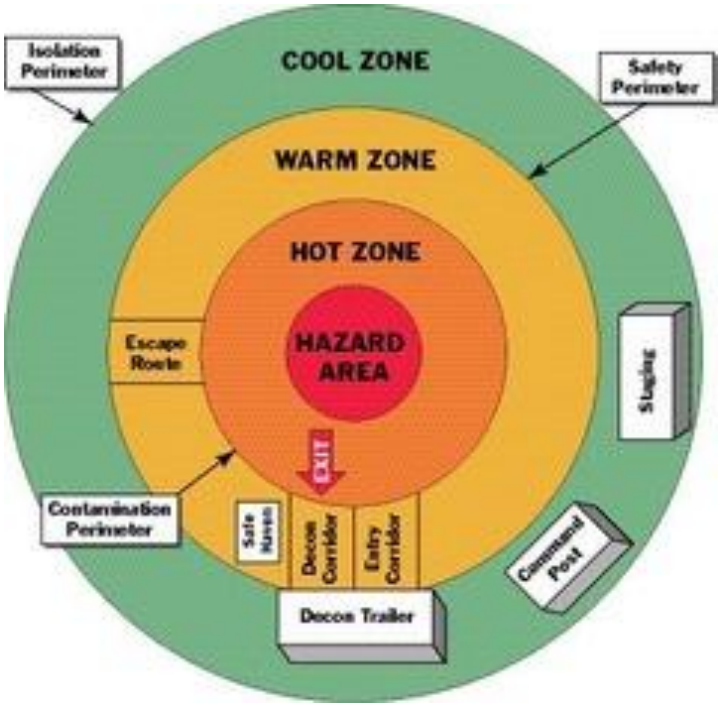
Chemical Removal

- Water and detergent washing
- Water and bleach washing
- Dry cleaning

Decontamination Line

Think of walking through a cafeteria line. The following picture shows the critical areas:



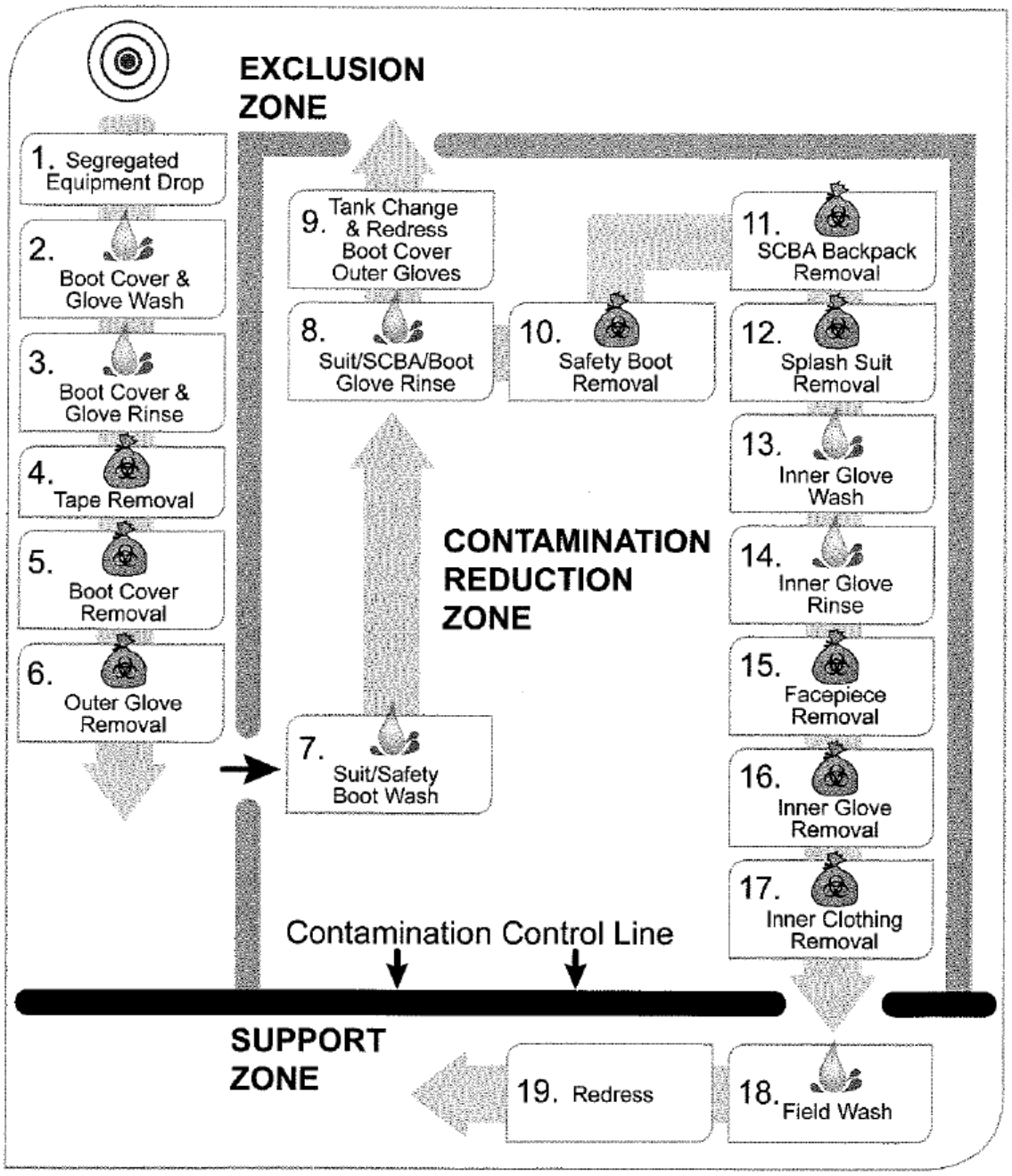


The decontamination line will have separate areas for personnel, tools and heavy equipment. Typically, tools and equipment are left inside of the Hot Zone until no longer needed or the job is completed.

Entry and exit areas are clearly marked. Dressing stations are separated out from redressing stations.

In hot weather a cooling station may be included.

For Level A and B EPA recommends a full 19 step decontamination process:



Stations 1-6 are inside the exclusion zone.

Stations 7-17 are in the contamination reduction zone.

Stations 18-19 are in the support zone.

<u>Decontamination Effectiveness</u>

Visual observation- You might be able to see the hazardous material still on clothing or equipment.

Ultraviolet light- Certain contaminates can bee seen under UV exposure.

Cleaning solution analysis- Take a bucket of dirty water used for final rinse and have it analyzed for contaminates. More washing may be needed.

Wipe sampling- A collection swab is wiped over the surface of the protective clothing. The swab is then analyzed for contaminates. This one may take some time.

Testing for permeation- Used clothing are taken to a lab for testing. Again, this one can take some time.

Equipment Decontamination

This process involves two steps. Step one. Wash all equipment with a decontamination solution and brushes. Larger equipment may use steam lines. Start at the top and work down. Just like water. Downside of steam or pressure washing is over spray.

Second step in decontamination is to rinse all equipment with water. Wipe equipment down with disposable towel and dispose of properly.

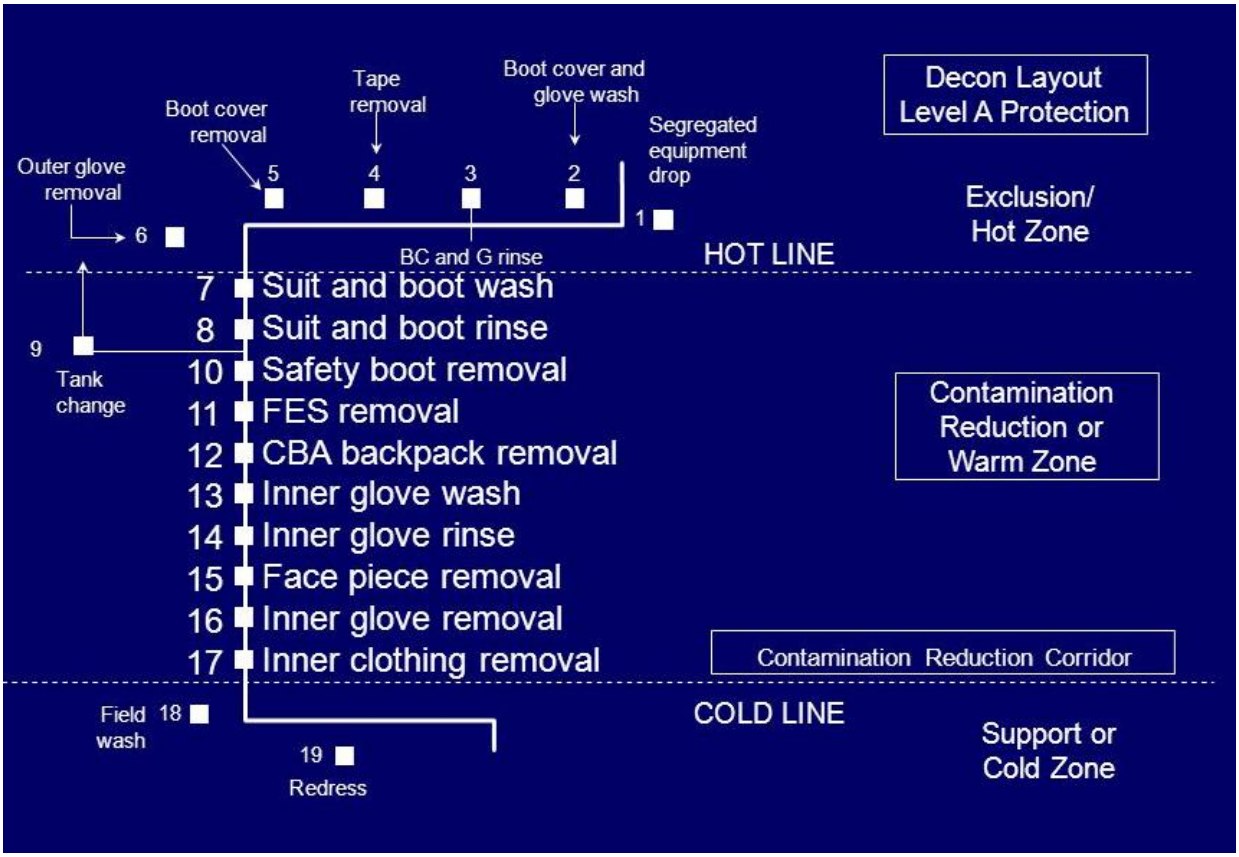
Emergency Decontamination

If someone is injured, normal decontamination may have to wait, especially if someone's life is in danger. If heat stress is the cause of the emergency get them out of the suit as fast as possible. Emergency decontamination should have a plan in place for each site and activity.

Three typical emergencies are:

- Physical- If injury minor the decontaminate. For a critical injury begin medical treatment immediately.
- Heat stress- Heat stroke is the most serious heat-related illness. It can kill in a very short time. Treatment must start immediately.
- Chemical exposure- Flood a chemical burn with water. If the chemical burn is minor, then decontamination can take place first.

In all of these take a few seconds to assess so that a bad decision is not made.


Decon Layout
Level A Protection
Boot cover and glove wash
Tape removal
Boot cover removal
Segregated equipment drop
Outer glove removal
5
4
3
2
1
6
BC and G rinse
HOT LINE
Exclusion/
Hot Zone
7 Suit and boot wash
8 Suit and boot rinse
9
Tank change
10 Safety boot removal
11 FES removal
12 CBA backpack removal
13 Inner glove wash
14 Inner glove rinse
15 Face piece removal
16 Inner glove removal
17 Inner clothing removal
Contamination Reduction or Warm Zone
Contamination Reduction Corridor
Field wash
18
19
Redress
COLD LINE
Support or
Cold Zone

Review Questions

1. Describe an action that would be careless when working around hazardous materials and explain how that action could cause contamination.

2. What is the first and most effective decontamination procedure?

3. In general, how are the standard operating procedures for contamination avoidance different from those for contamination transfer?

4. What changes could occur that might alter a decontamination plan?

5. Describe how you would remove contaminants physically?

6. Describe the three methods of chemical decontamination.

   a. _____

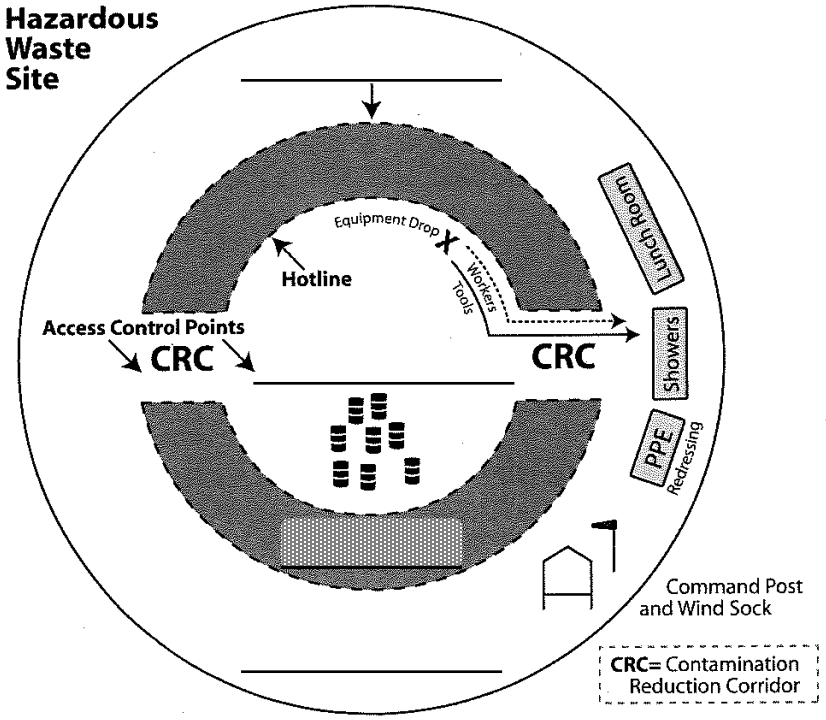
   b. _____

   c. _____

7. Put the following exclusion zone decontamination stations in the correct order from 1 to 5.

___ Segregated equipment drop
___ Tape removal
___ Boot cover removal
___ Outer glove removal
___ Boot cover and glove rinse

8. Label the four missing zones on the decontamination area diagram.



9. Which decontamination detection methods require lab analysis?

10. Why might a high-pressure wash of heavy equipment not be an appropriate decontamination method in all cases?

11. What situations might require the use of emergency decontamination procedures?

Chapter 10

Heat Stress

Supervisor training. Prior to assignment, supervisors must have training on the following topics:

- The information required to be provided to employees.
- The procedures the supervisor is to follow to implement the applicable provisions in this section;
- The procedures the supervisor is to follow when an employee exhibits signs or symptoms consistent with possible heat-related illness, including emergency response procedures;
- Procedures for moving employees to a place where they can be reached by an emergency medical service provider, if necessary;
- How to provide clear and precise directions to the emergency medical provider who needs to find the work site.

Heat illness is:

- Overheating of the body
- Inability of the body to cool itself
- Dangerous
- Can kill
- Is preventable

Heat illness can affect anyone. It can happen in logging, construction projects, landscaping, agriculture, field work, transportation, etc.

Environmental Factors

- Direct sun, heat and humidity
- More direct sun the greater the risk

Categories	Example Activities
Resting	•Sitting quietly •Sitting with moderate arm movement
Light	•Sitting with moderate arm and leg movements •Standing with light work at machine or bench while using mostly arms •Using a table saw •Standing with light or moderate work at machine or bench and some walking about

All other clothing	89°
Double-layer woven clothes including coveralls, jackets and sweatshirts	77°
Nonbreathing clothes including vapor barrier clothing or PPE such as chemical resistant suits	52°

Heat Index	General Effect of Heat Index on People in Higher Risk Groups
80-89 *Caution*	Fatigue possible with prolonged exposure and physical activity.
90-104 *Extreme Caution*	Sunstroke, heat cramps, and heat exhaustion possible.
105-129 *Danger*	Sunstroke, heat cramps, and heat exhaustion likely, and heat stroke possible.
130 or higher *Extreme Danger*	Heat stroke highly likely with continued exposure.

Categories	Example Activities
Moderate	•Scrubbing in a standing position •Walking about with moderate lifting or pushing •Walking on level at about 4 miles/hr while carrying 6-7 pound weight load
Heavy	•Carpenter sawing by hand •Shoveling dry sand •Heavy assembly work on a non-continuous basis •Intermittent heavy lifting with pushing or pulling (e.g. pick-and-shovel work)
Very Heavy	•Shoveling wet sand

Clothing

- Personal protective equipment (PPE)
- Heavy clothing
- Multiple layers
- Dark colored clothing

Personal Factors

Dehydration

- You need to drink more water when it's hot

Loss of electrolytes

- When you sweat you lose electrolytes
- Electrolytes are needed for your body to function

Illness/fever

Age, weight, and personal fitness

Medical conditions

- Heart conditions
- Diabetes
- Etc.

Certain medications

✓ Allergy medicines (antihistamines)
✓ Cough and cold medicines
✓ Blood pressure and heart medicines
✓ Irritable bladder or bowel medicines
✓ Laxatives
✓ Mental health medicines
✓ Seizure medicines
✓ Thyroid pills
✓ Water pills (diuretics)

Preventing heat illness – Work Smart

- Schedule the hardest work for the cooler parts of the day.
- Alternate heavy work with light work when possible.

- Increase breaks if:
  - Conditions are very hot; or
  - The work is physically demanding; or
  - Protective clothing limits evaporative cooling
- Establish a “Buddy System” to keep an eye on co-workers for symptoms of heat illness such as crankiness and denial.
- Work in the shade or out of direct sun when possible
- Wear light colored clothing

It is important to drink small quantities of water throughout the day. One quart or more over the course of an hour may be necessary when the work environment is hot and you may be sweating more than usual as you work. Under normal conditions we need half our body weight in ounces of liquid a day.

DO

- Drink plenty of water (about a cup every 15 minutes)
- Start work well hydrated
- Consider sports drinks

DO NOT

- Drink pop and other sugary drinks
- Drink lots of coffee and tea
- Drink alcohol
- Wait for thirst before drinking water

Acclimatization is important

Not being used to the heat. People need to adjust (acclimate) to hot working conditions over a few days.

Approximations

- Can take 4-10 days. Depends on you and the working conditions
- If new to the area and conditions – work at about 50 - 60% of normal rate on first day
- Increase work about 5 to 10% per day

There are five main kinds of heat illness:

- Sunburn – red, hot skin
- Heat rash – often under clothing
- Heat cramps – in arms or legs with physical labor
- Heat exhaustion – more serious effect
- Heat stroke – can be fatal

Top Ten Signs You Are Dehydrated

- You're Overheating
- You Stop Producing Tears
- You Feel Tired or Fatigued
- You Feel Lightheaded or Dizzy
- You Get Muscle Cramps or Spasms
- You Have Heart Palpitations
- Your Skin Lacks Elasticity
- You're Constipated
- Your Urine Is Dark Yellow
- Your Mouth Is Dry and Your Tongue Is Swollen

Illness	Signs and Symptoms	First Aid and Treatment
Sunburn	•Red, hot skin •May blister	•Move to shade, loosen clothing •Apply cool compresses or water
Heat rash	•Bumpy skin •Red Itchy skin •Skin infection	•Apply cool water or compresses •Keep affected area dry •Control itching and infection with prescribed medication.
Heat Cramps	•Muscle spasms in legs or abdomen •Abnormal body posture •Grasping the affected area	•Move person to a cooler location •Stretch or massage muscles for cramps •Get medical evaluation if cramps persist •Give cool water or electrolyte containing fluid to drink

Illness	Signs and Symptoms	First Aid and Treatment
Heat Exhaustion	•Headaches •Clumsiness •Dizziness/lightheadedness/fainting •Weakness/exhaustion/fatigue •Heavy sweating/clammy/moist skin •irritability/confusion •Nausea/vomiting •Paleness •High pulse rate	•Move person to a cooler place (do not leave alone) •Loosen and remove heavy clothing that restricts evaporative cooling •If conscious, provide small amounts of cool water to drink •Fan person, spray with cool water, or apply a wet cloth to skin to increase evaporative cooling •Lay flat and elevate feet •Evaluate mental status (ask who, where, when questions) •Call 911 if not feeling better within a few minutes
Heat Stroke	•any of the above, but more severe •sweating may or may not be present •red or flushed, hot dry skin •bizarre behavior •mental confusion or losing consciousness •panting/rapid breathing •rapid, weak pulse •seizures or fits •can be fatal	•**call 911** •move person to a cooler place (do not leave alone) •cool worker rapidly •if conscious, provide small amounts of water to drink •loosen and remove heavy clothing that restricts evaporative cooling •fan person, spray with cool water, or apply a wet cloth to skin to increase evaporative cooling •lay flat and elevate feet •monitor airway and breathing, administer CPR if needed

Untreated heat exhaustion may progress to heat stroke. Symptoms of either should always be taken seriously

Note: Heat exhaustion or heat stroke may develop over a few days.

The telling difference is mental confusion/disorientation in ALL heat stroke victims. You can ask these 3 questions.

"What is your name?"

"What day is this?"

"Where are we?"

If a worker can't answer these questions, assume it is heat stroke.

What do you do if someone is suffering from heat exhaustion?

- Move person to cooler/shaded area to rest and if possible, lay the worker down.
- Contact your first aid trained person.
- Do not leave him or her alone.
- Loosen and remove heavy clothing that restricts evaporation and cooling.
- If worker is alert and not nauseated, provide fluids such as cool water, juice, sports drinks, or non-caffeinated soft drinks. (About a cup every 15 minutes)
- Fan the person, spray/mist with cool water, or apply a wet cloth to his or her skin but if the worker begins to shiver, stop cooling.
- Call 911 if person does not feel better in about 15 minutes.
- Do not further expose the person to heat that day. Have them rest and continue to drink cool water and electrolyte drinks.

What do you do if someone is suffering from heat stroke? **Call 911**

Seconds count!

- While waiting for medical help to arrive:
- Move the victim to a cool shaded area
- Remove clothing that restricts cooling.
- Cool the person using whatever methods you can

Stop all activity if you become:

- Lightheaded
- Confused
- Weak
- Faint
- Or have a pounding heart or trouble breathing

Tell your supervisor if you or one of your co-workers experience symptoms of heat-related illness.

You have a right to all the protections provided by this standard.

Your employer has the responsibility to follow the requirements of the standard in order to prevent heat – related illness in you and your co-workers.

It is important for you to follow the instruction and training provided by your employer.

You should contact your supervisor as soon as possible if you have any questions about your rights, or if you have concerns about your fellow employees' safety.

Recap

- Drink water frequently!!
- Know the signs and symptoms of heat related illnesses and take them seriously
- Consider sports drinks when sweating a lot
- Avoid alcohol, caffeinated drinks, and heavy meals before or during work
- Work smart
- Acclimate
- Wear appropriate clothing
- Take regular breaks
- Keep an eye on your buddy!

Heat Stress/Cold Stress Discussion

Read the following scenarios and discuss them in a group:

1. You are working on the same job with 10 other workers. Why can you get heat stress and not your coworkers?

2. You check the temperature before you set out for the job, and it is not that hot today. You still get heat stress. Why?

3. You and your coworkers are working outside in a slight rain in 45 degree F temperatures on a demolition project. One of your coworkers starts to shiver and says he is cold, but you don't think much of it because the rain makes it feel chillier than it should be at 45 degrees. You rarely get cold at that temperature. A half hour later you notice he is moving slowly and seems confused about some of the work. You ask him how he is, and he says he has trouble holding some of the tools because his fingers feel numb, although he actually feels warmer now. Someone says it sounds like hypothermia. Others say that can't be right because it's only 45 degrees. Who is right about the worker's condition? Describe the symptoms that lead you to that conclusion:

4. You have to move between a hot environment inside the plant to a cold environment outside on railroad tracks along the river during the winter. What should you do to prevent temperature-related illnesses? How would you dress to deal with both temperature ranges?

Review Questions

1. When does any heat stress occur in the body?

2. What are the signs of heat stroke, and what should you do if you think a coworker is suffering from it?

3. What are the signs and symptoms of heat exhaustion, and what should you do if you think you may be suffering from it?

4. List as many work practices as you can that could reduce your risk of heat-related illnesses:

5. What other factors besides air temperature affect whether or not you develop a cold stress illness?

6. Describe the signs and symptoms you would look for in the following cold stress conditions and then describe the treatment for each:
   - Frostbite:
   - Hypothermia:
   - Trench foot:
   - Chilblains:

7. List some work practices for avoiding cold stress injuries:

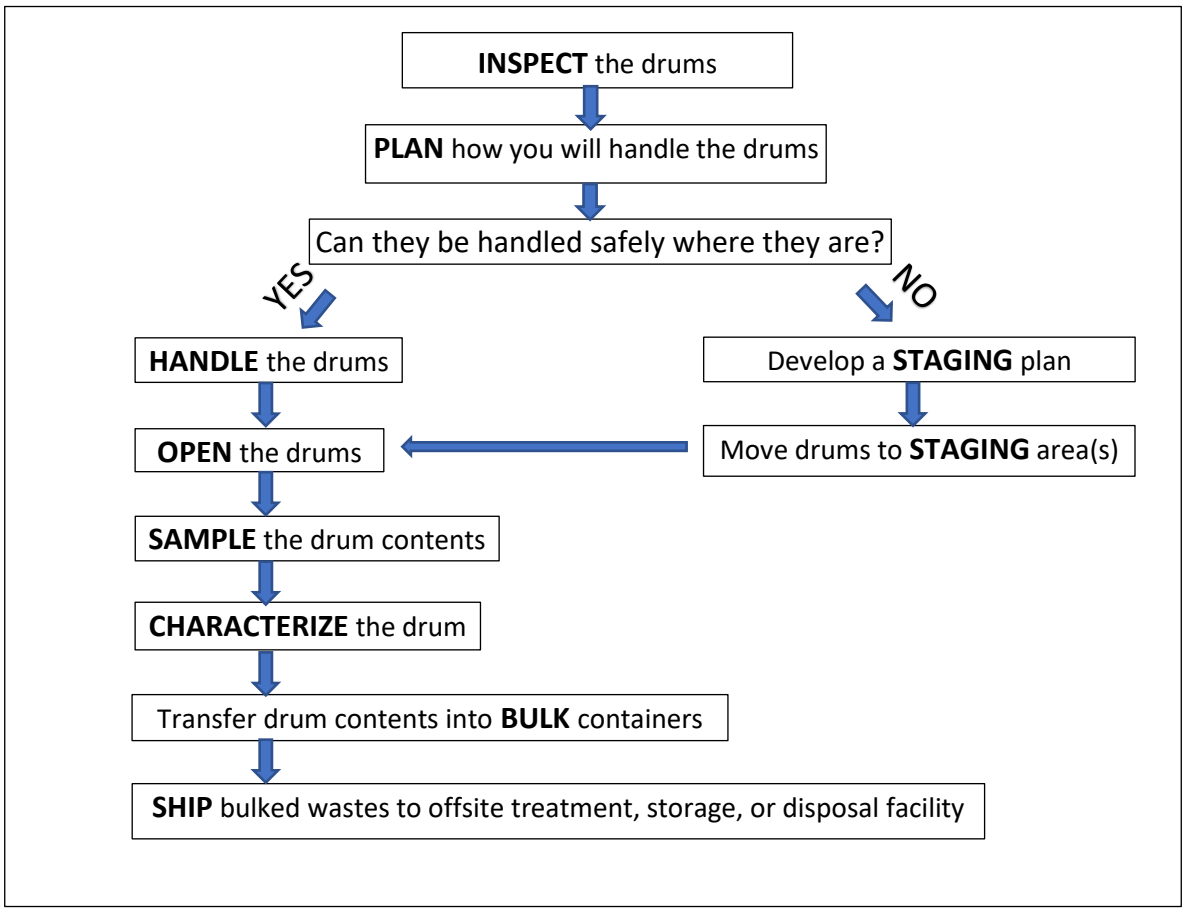
Chapter 11

Drum Handling

Not knowing the contents of a container can put yourself and your coworkers at risk. Even surrounding neighborhood areas may be affected. The chemicals may be radioactive, explosive, toxic, and or even deadly. They may leak, or the drums may simply collapse when moved. In addition, moving containers can be strenuous or dangerous. Safe drum handling involves several steps:

1. Inspection
2. Planning
3. Staging
4. Handling
5. Opening
6. Sampling
7. Characterization
8. Bulking
9. Shipping

The following chart summarizes the process:



Inspection is probably the most important step in the process. Involved with the inspection is assessment to determine the conditions and integrity of the drums or containers. The information received from the assessment will determine the Staging and Handling. Some things to look for when assessing are:

- Symbols, words or other markings on the drum indicating its contents
- Signs of deterioration i.e. rust, leaks, collapse
- Evidence of drum under pressure
- Drum type:
    - Drum with liner- may indicate highly corrosive contents
    - Polyethylene or PVC lined drum- often contains strong bases or acids
    - Exotic metal i.e. aluminum, stainless steel indicating extremely dangerous material
    - Single walled drum used as a pressure vessel, which may contain pressurized gas
- Conditions around drum which may give clues.

Always assume:

- Drums might be buried
- Unlabeled drums contain hazardous material
- Drums may be mislabeled because of re-use

Classifying the Hazard

Drums can be classified as:

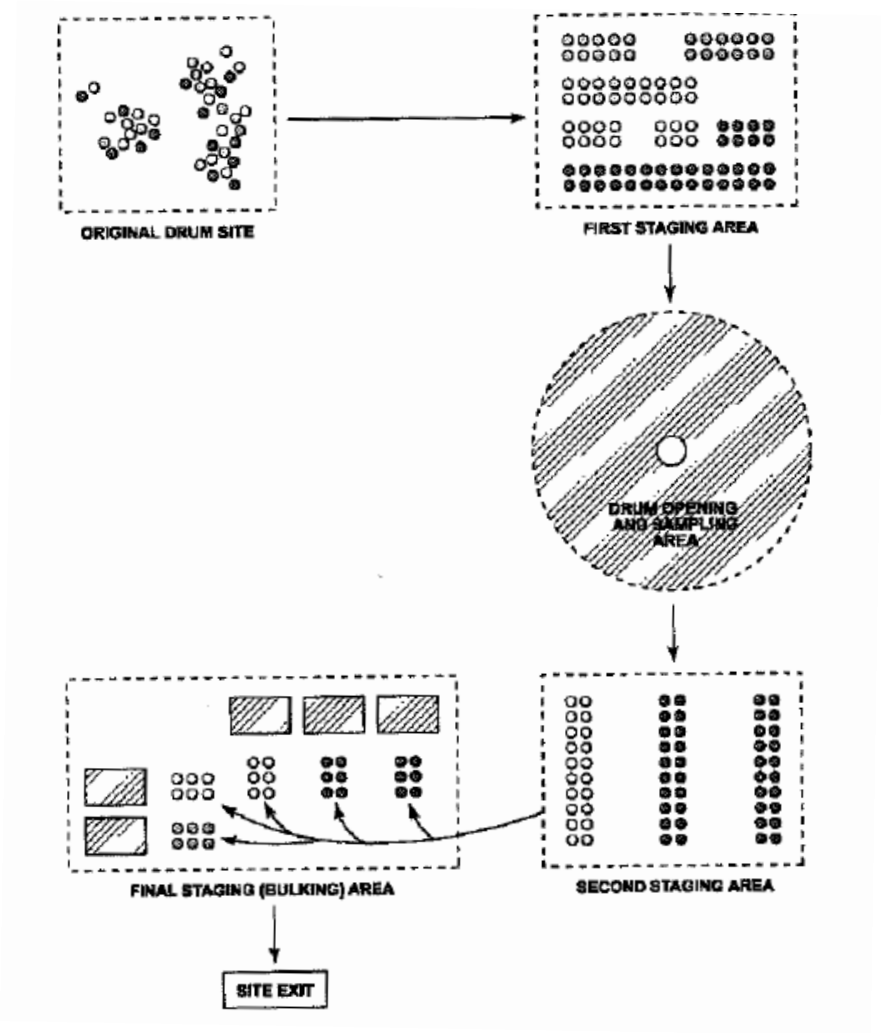
- Radioactive
- Leaking/deteriorated
- Bulging
- Explosive/Shock sensitive
- Lab pack

Staging

Staging is determined based on the condition of each individual drum. If drums can be moved, then staging is good choice. Typically, there are five types of staging areas:

- Initial staging area-Drums are organized according to type, size, and suspected contents
- Opening area- Here drums are opened, sampled and resealed. Area is a safe distance original waste site and storage site to prevent reactions.
- Sampling area- During large scale or emergency a separate area may be needed. This is also set up at a distance from potential exposure to people or other contaminants
- Second staging area- This is also known as a holding area pending characterization of contents. Drums are sealed up in this area. This area should have dikes or spill containment.

- Final staging area- Here the substances have been characterized and are bulked for transport to treatment facilities or disposal. This area should contain dikes or spill containment since drums may be stored for a time.



Handling Drums

- Keep overpack drums-larger drums in which you place leaking or damaged drums for shipping
- Have a supply of sorbent near areas where spills may occur
- For major spills build containments or dikes
- Have trained workers for spill responses who know how to isolate and contain a spill
- Have proper equipment for drum handling i.e. grappler

Opening Drums

Depending on the hazard assessment, full body protection may be needed. Work area needs to have conditions including air quality continuously monitored.

If possible, use remotely operated tools for drum opening or puncturing

Use caution when opening possible explosive contents. Tools should not create a spark.

Do not open a series of drums until contents can be determined to be compatible or separate so fumes cannot mix.

Sampling

Consider these guidelines:

- Research background information about the waste
- Determine which drums to sample
- Select appropriate sampling devices and containers
- Have a procedure set up to classify and categorize as you go- your memory is not that good!
- Have procedure set up for drawing storing and transporting the sample to the lab
- Have someone determine appropriate PPE to use for next phase of work
- Treat all tools, lids etc. as containing contaminates so contents are not cross contaminated

Characterization

Characterization is done by a lab. Sometimes this is done by an onsite lab to speed up the process.

Color Codes	Hazard Words
Orange	Explosive or Blasting Agent
Red	Flammable or Combustible
Green	Nonflammable
Yellow	Oxidizer, Oxygen, or Organic Peroxide
White with red stripes	Flammable solids
Yellow and white	Radioactive
White and black	Corrosive
White	Poison, Chlorine
Blue	Dangerous When Wet
Special	Biological Agent

Bulking

Bulking involves dispatching the items to a waste facility. The tanks or vacuum trucks. This is only done after all the waste it analysis of compatibility.

Tanks, hoses transfer pumps are all fully inspected to ensure no spills. In some cases, grounding of the drums is necessary to prevent explosion hazards.

Other hazards are splashes from contaminates onto the workers. Ensure proper PPE is used at all times.

Shipping

During this phase drums are taken to an off-site treatment storage or facility. Both federal DOT (49 CFR 171-178) regulations and EPA (40 CFR 263) regulations must be followed. Here are some guidelines:

- Locate the bulk storage as close as possible to the site exit
- Have adequate room for maneuvering trucks
- Minimize driver's time on site and have PPE for the drivers as needed
- Check drums and containers for seals and properly tightened lids
- Do not double stack drums
- Use packing materials so drums do not shift during transport
- Keep bulk solids below the truck sides
- Properly line truck beds with 6 or 10 mil plastic before filling
- Transport truck tires should never touch any contaminated soils
- Use proper decontamination before truck leave site.

Drum Handling Review Questions

1. What are four steps in safe drum handling BEFORE opening a drum?

2. What are the four items in safe drum handling AFTER opening a drum?

3. What are some visual clues to look for when inspecting a drum to determine what it might contain?

4. Which of these signs indicates that a drum is under pressure:

a. Leaks
b. Decay
c. Swelling
d. Open lid

5. If as a general rule, you don't want to remove drums, why is staging sometimes necessary?

6. Give three examples of drum handling equipment. Which is considered especially effective and safe for operators?

7. What are the general categories of possible drum hazards?

8. For which types of drums should an expert be called in for consultation before doing any moving or handling?

9. Which of these is a potential danger of moving a drum that contains shock sensitive materials?
   a. Contents could give off a bad odor.
   b. It may explode.
   c. Contents may leak.
   d. Contents may swell.

10. Which one of the following would require moving hazardous waste from one drum to a new drum?
   a. The first drum is leaking or deteriorated.
   b. The first drum is sealed.
   c. The first drum is properly marked.
   d. The first drum has no labeling.

11. What kinds of chemicals can be bulked: compatible or incompatible?

12. Name at least five guidelines to follow in shipping hazardous waste:

Chapter 12

Confined Space

It is a space that meets all of the following requirements:

- Large enough and shaped so someone can fully enter and do work AND
- Entry and/or exit is limited or restricted AND
- Is not designed for continuous human occupancy

Pipe in Excavation:

- The work is covered by the Confined Space rule if you have to bodily enter the sewer space, which is an existing sewer pipe or manhole, or new construction connected to an existing sewer.
- The work does not fall under the Confined Space Rule if the sewer space is large enough to bodily enter but entry is not required. Excavation rules apply.
- If work is performed in an underground pipe that is not part of or connected to a sanitary sewer and is not part of excavation work, then the work is covered by the Confined Space Rule.

In the Confined Space Rule there are two main types of hazards: physical and atmospheric. They may be present or have the potential to be present.

Prior to entry, hazards should be anticipated, identified, evaluated, eliminated if a physical hazard, and controlled or eliminated if an atmospheric hazard.

Entry- The action by which a person passes through an opening into a permit-required confined space. Entry includes ensuing work activities in that space and is considered to have occurred as soon as any part of the entrant's body breaks the plane of an opening into the space

A physical hazard is defined as an existing or potential hazard that can cause death or serious physical harm. It includes but is not limited to:

- Explosives
- Radiation
- Engulfment
- Temperature extremes
- Inwardly converging surfaces
- Noise, if it prevents the ability to communicate or hear warnings
- Mechanical, electrical, hydraulic and pneumatic energy
- Chemicals that can cause death or serious physical harm through skin or eye contact

An atmospheric hazard is an existing or potential atmosphere that may expose employees to the risk of:

- Death
- Incapacitation
- Impairment of ability to escape without help
- Injury
- Acute illness

As a result of one or more of the following conditions:

- A flammable gas, vapor, or mist in excess of 10 percent of its lower flammable limit
- An airborne combustible dust

- An airborne concentration of a substance that exceeds the dose or exposure limit specified by an Oregon OSHA requirement (dust that obscures vision at a distance of 5 feet is included)
- An atmosphere that presents an immediate danger to life or health (IDLH)
- An atmospheric oxygen concentration below 19.5 percent or above 23.5 percent (oxygen deficiency and oxygen enrichment)

In other words, any atmosphere that could result in death or serious injury to a worker as caused by oxygen deficiency or enrichment, toxic materials, and flammable or explosive materials. The emphasis is on acute hazards, not chronic.

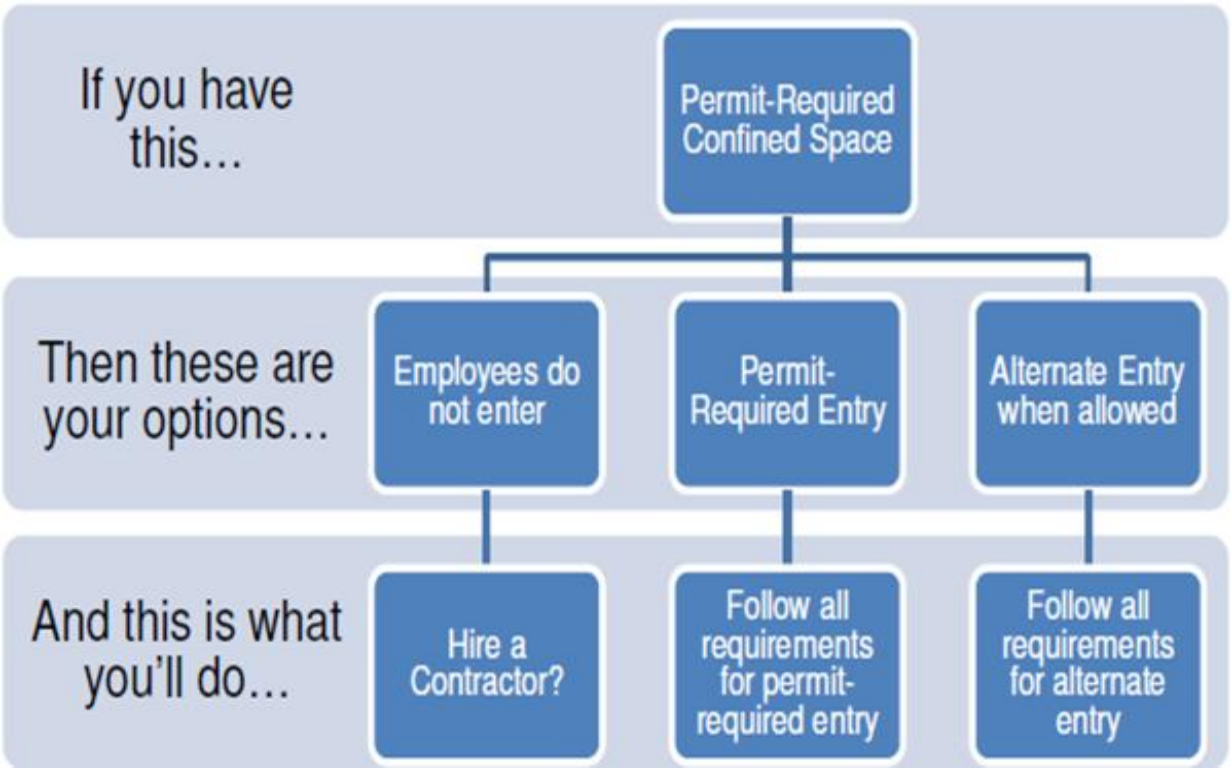
While welding, noise, falls asbestos, lead and silica may be hazards in a confined space, they are all covered under specific rules. For example, if lead is the only hazard, then the Lead Rule applies, not the confined Space Rule

For the purpose of this rule, tagout is allowed for the permit entry, but lockout is required for an alternate entry.

In some cases, such as with painting and welding, exhaust ventilation should be used as well as forced or ventilation to control the hazard

You must have a way for employees to recognize your permit-required confined spaces. In addition to training, you can use signs, labels or tags. The rule does not require each space to have its own sign—it's acceptable to identify a group of similar spaces, such as manholes, in a general way.

After you have identified and evaluated your permit-required confined spaces, you'll need to make some decisions about how those spaces will be entered.



Employees Do Not Enter-Employees must know how to identify permit-required confined spaces, and that they are not allowed to enter.

If you have someone else enter your permit-required confined spaces, such as a sub-contractor, then you are required to provide them any information you have about the hazards of the space (e.g. why you consider the space to be a permit-required confined space).

Entry with a Permit – Procedures-You must have the following in place to enter a permit space:

- Space to be entered
- Purpose of the entry
- Date, start, and stop times of the permit
- Hazards of the space
- Acceptable entry conditions
- Results of initial tests and periodic monitoring, or the period for continuous monitoring, and the names or initials of the testers and when the tests were performed

Entry with a Permit- To enter a permit-required confined space with a full permit, do or have the following:

Evaluations

- Permit entry procedures
- Equipment
- Personnel
- Rescue
- Training
- Multi-employer worksite procedures
- Records
- Permit-required confined space written entry program and permits
- Measures to isolate the space and eliminate or
- controls hazards before entry
- Names of entrants and current attendants
- Signature of the original supervisor authorizing entry
- Current entry supervisor
- Communication procedures for entrants and attendants
- Equipment provided for entry
- Rescue services available and how to contact them
- Other information needed for safety
- Additional permits for work in the space, such as for hot work
- Any problems encountered during entry
- Procedures for issuing permits
- Testing for atmospheric hazards before entry
- Provide results of atmospheric testing to entrants
- Maintain safe entry conditions for the duration of the entry
- Follow all actions and precautions on the permit

- If you have to evacuate, re-assess the conditions of the space to ensure it is safe for re-entry and ensure the permit reflects the evacuation and subsequent re-assessment.

Frequency of Atmospheric Testing

- Before every entry. This includes the beginning of the shift and breaks
- Gas Monitor should be placed inside the space to provide a continuous read of conditions
- Before entry the space entered should be checked at all levels. Top, Middle and Bottom.
    - Methane is lighter than air
    - Carbon Monoxide is the same as air
    - Hydrogen Sulfide is heavier than air

All equipment must be maintained and used in accordance with the instructions from the manufacturer. For example, if the manufacturer's directions say to perform a factory calibration, then that's what you need to do. Bump testing of air monitoring equipment is recommended prior to every use.

Entrants must:

- Know about hazards that they may face during entry and the signs, symptoms and consequences of exposure
- Communicate with the attendant so the attendant can monitor their status and warn them when they need to evacuate
- Alert the attendants about hazardous conditions in the space or symptoms of exposure

Exit the space immediately when:

- An order to evacuate is given by the attendant or the entry supervisor
- An entrant recognizes any warning sign or symptom of exposure to a dangerous situation
- An entrant detects a dangerous or hazardous condition
- An evacuation alarm is activated

Attendants must:

- Know the hazards entrants may face during entry and the signs, symptoms, and consequences of exposure
- Be aware of the behavioral effects of hazards on entrants
- Keep an on-going count of entrants and ensure that the count identifies who is in the space
- Remain outside the space during entry operations until relieved by another attendant
- Communicate with entrants to monitor their status and to alert them if they need to evacuate
- Communicate with entrants to monitor their status and to alert them if they need to evacuate
- Monitor activities inside and outside the space and order entrants to evacuate immediately under the following conditions:
    - ✓ A dangerous or hazardous condition is detected
    - ✓ If the behavioral effects of hazard exposure are detected
    - ✓ If there is a dangerous situation outside the space

- ✓ If the attendant cannot perform all required duties

- Summon emergency services as soon as entrants need to escape from the space
- Warn unauthorized persons to stay away if they approach the space
- Perform non-entry rescues following your established rescue procedure
- Do nothing that would interfere with monitoring and protecting an entrant even while monitoring another space.)

When entrance covers are removed, promptly guard the opening with a railing, temporary cover, or other temporary barrier to prevent accidental falls through the opening and protect entrants from objects falling into the space. WAC 296-809-60004*

Must be guarded by standard covers which need not be hinged in place. While the cover is not in place, the manhole opening shall be protected by a standard guardrail system. WAC 296-155-246009-4-f*

* LnI Does allow the attendant to use administrative controls to keep workers out of area

Entry Supervisors must:

- Know the hazards that entrants may face during entry, including the signs, symptoms, and consequences of exposure
- Understand how to control or eliminate hazards associated with the space
- Verify that all tests, procedures and equipment specified by the permit are in completed or in place before signing the permit and allowing entry to begin

Non-entry rescue

This means nobody beyond the entrant goes in. It also typically means the entrant is wearing a harness that is attached to a retrieval device that is designed to allow them to be pulled them out of the space by somebody else, such as the attendant.

Entry rescue

This means somebody goes in. They must have equipment and training and follow all requirements in the rule.

Third-party rescue

This means somebody else goes in, with whom you have made arrangements to do so. The third-party must follow entry requirements. Simply planning to rely on 911 services does not meet requirements of the rule.

Whatever option you choose, rescue procedures must include :

- A process for summoning rescue services
- A process for summoning emergency medical services or transporting injured entrants to a medical facility.
- A way for the Safety Data Sheet (SDS) or other similar written information be kept at the worksite, and be made available to the medical facility treating an exposed entrant.

- They must also have practiced performing a rescue before the entry, but no more than 12 months before.

When workers are mobile, they do not need to do the annual practice (either entry or non-entry) if the rescue team does a practice rescue in the space that needs to be entered, before the actual entry.

Training is required:

- Before an employee is assigned permit-space duties
- Before there is a change in an employee's assigned duties
- When there is a hazard for which an employee has not been trained
- When there are changes to the permit program
- When the permit audit shows deficiencies
- When there is a deviation from established procedures or an employee's knowledge of the procedures is inadequate

Awareness training is required for employees who work or may work in areas where permit spaces are present.

It must explain the permit-space program, the entry permit system, the alternate entry procedures, if used, and how to recognize permit spaces in their work area.

It provides a basic overview of the permit space program.

Record each employee's training, including the employee's name, the trainer's signature, the training date, and the employee's responsibilities.

Employees must be able to inspect their training records.

Alternate Entry

Alternate entry is a specific procedure for entering a permit space without a full permit.

An attendant is not required; rescue procedures are not required; and there are fewer documentation requirements.

You need to do the following:

- Eliminate all hazards

OR

- Eliminate all physical hazards in the space and control all hazardous atmospheres with continuous ventilation

Alternate entry cannot be used to enter a continuous system unless you can isolate the area to be entered from the rest of the space, or can demonstrate the conditions that caused the hazard or potential hazard no longer exist within the system during the entry, or can demonstrate that engulfment cannot occur and continuous ventilation in the area to be entered is sufficient to control atmospheric hazards.

Develop and implement alternate entry procedures that address the following:

- Who can authorize alternate entry procedures and is responsible for ensuring safe entry conditions
- The hazards associated with the space
- The methods used to eliminate the hazards
- The methods used to ensure the hazards have been eliminated
- The methods used to test the space for all hazardous atmospheres
- The methods used to determine if unsafe conditions occur before or during entry

The criteria and conditions used for evacuating the space

- The methods for training employees in these procedures
- The methods for ensuring employees follow these procedures

Alternate entry procedures do not have to be in writing, but you may find it beneficial to do so.

When using ventilation to control atmospheric hazards:

- Use only properly calibrated direct-reading meters to test the atmosphere.
- Test the atmosphere for all identified atmospheric hazards before entering the space.
- Do not allow employees to enter until testing verifies that all identified atmospheric hazards are adequately controlled by the ventilation.
- Perform continuous monitoring for all atmospheric hazards during the entry.

Immediately evacuate the space:

- When monitoring indicates the return of atmospheric hazards.
- Upon any failure with the direct-reading instrument.
- Upon any failure with the ventilation.
- When a new hazard is introduced or conditions within the space change.

If a space is evacuated, it cannot be re-entered as an alternate entry unless:

- The conditions that necessitated the evacuation are corrected; and
- The re-entry is treated and documented as a new entry.

If a space is evacuated, it cannot be re-entered as an alternate entry unless:

- The conditions that necessitated the evacuation are corrected; and
- The re-entry is treated and documented as a new entry.

There are ten items that must be documented, if they apply:

- The location of the space
- The hazards of the space
- Measures taken to eliminate the hazards
- Measures taken to control the atmospheric hazards
- The identity of the direct-reading instruments used to test the atmosphere
- The results of the atmospheric testing
- The date of entry
- The duration of the entry
- Any and all conditions that required the evacuation of the space
- The name, title, and signature of the person responsible for ensuring the safe entry conditions

Maintain this documentation for the duration of the entry at the location of the entry.

The rule does not require the documentation to be kept after the entry is complete, but it would be a best practice to do so. It would allow you to evaluate your alternate entry procedures for effectiveness and to make improvements.

Multi-employer Worksites

Let them know about the hazards of the spaces and about any precautions you require to protect your own employees.

- When your employees are working in a space and someone else's employees are working in or around that space, coordinate entry with the other employers so your employees are not exposed to hazards created or discovered by the other employees, and vice-versa.
- Discuss any hazards created or encountered, after the operation is finished.

After a permit entry, keep cancelled permits for at least one year from the date the permit expires.

After an alternate entry, keep the entry document where the space is located for the duration of the entry. There is no requirement to keep it after the entry. It would be a best practice to keep it for review of the effectiveness of the procedure.

If an air monitor is used that data logs, and the monitoring is associated with a specific person, then the logged data can be used as an exposure record. If so, then it must be kept in an accessible form for 30 years.

Review Questions

1. You have been sent to work in a space that is large enough and shaped for a human to enter. There is one small opening and no natural ventilation. Does this space meet the OSHA definition of a confined space?

2. List the four characteristics of a permit-required confined space:

3. Is the following statement true or false? "The information presented in this chapter certifies you to be assigned confined space work." Tor F

4. The pre-entry air test of a confined space has a reading of 25% oxygen by volume. Is this an oxygen deficient or oxygen enriched atmosphere? What is the primary danger associated with this atmosphere?

5. What is the definition of an oxygen-deficient atmosphere?

6. What elements are necessary for a flammable or explosive atmosphere to exist?

7. What two types of atmospheric testing must be done to ensure your safety?

8. What are the three specific pre-entry atmosphere tests required for a confined space? In what order must these tests be performed?

9. Why must air in a confined space be tested at the top, middle, and bottom of that space?

10. Why must trenches or hollows be monitored for hazardous atmospheres?

11. What's the difference between general ventilation and local exhaust ventilation?

12. Is it more efficient to use a supply system or exhaust system to ventilate an area?

13. Describe how a lockout or tagout keeps you safer in hazardous atmospheres in a confined space:

14. Is the following statement true or false? "The majority of the deaths and illnesses associated with confined spaces result from atmospheric hazards." T or F

Chapter 13

Trenching and Excavation

Benching–excavating the sides of an excavation to form one or a series of horizontal levels or steps

Competent Person-One who can identify existing or predictable hazards in the surroundings that are unsanitary, hazardous, or dangerous to employees. Also has authorization or authority by the nature of their position to take prompt corrective measures to eliminate them.

Excavation – a man-made cut, cavity, trench, or depression formed by earth removal.

Hazardous Atmosphere - an atmosphere which may be explosive, flammable, poisonous, or oxygen deficient

Ramp - An inclined surface that is constructed from earth or from structural materials

Trench – a narrow excavation. The depth is greater than the width, but not wider than 15 feet.

Sheeting – Members of a shoring system that retain earth in position

Shield - a structure able to withstand a cave-in and protect employees

Shoring - a structure that supports the sides of an excavation and protects against cave-ins

Sloping - a technique that employs a specific angle of incline on the sides of the excavation. The angle varies based on assessment of impacting site factors.

Structural Ramp – A ramp built of steel or wood, usually used for vehicle access

Uprights - the vertical members of a trench shoring system placed in contact with the earth

Wales - horizontal members of a shoring system

Appoint Competent Person to do:

- Soil evaluations
- Daily Inspections
- Shoring and sloping evaluations and have
- Stop Work Authority

Qualifications

- Knowledge of soils and soil classification
- Understands design and use of protective systems
- Ability to recognize and test hazardous atmospheres
- Documented training
- Prior excavation experience

Responsibilities

- Site safety briefings on excavation safety
- Daily excavation inspections
- More frequent if conditions change (e.g. freeze/thaw, rain, vibration)

- Physically at the excavation site anytime worker are exposed
- Classifications of soils

A cave in can weigh as much as two Full size trucks. Workers die from being crushed.

Locates

- Locates for Washington and Oregon expire 45 days after "Ticket life" means the 45 calendar day period after an excavator provides notice to the Oregon Utility Notification Center. RCW 19.122.030 states locate marks expire 45 days from the date the excavator provides notice.
- Aboveground Utilities
- De-energize or
- Isolation from power lines
- Minimum 10’ 50v to 50,000v

Hazardous Atmosphere

Test @ 4’ if suspected

- LEL 10% of explosive level
- Oxygen 19.5 – 23.5
- CO 35 ppm - Biggest Hazard
- H2S 10 ppm
- Petroleum
- Other toxics

Vehicular Traffic

Wear High Visibility garments or Class 2 as required

Class 2 or 3 required working on or near roads

Walkways

Walkways or bridges with standard guardrails must be provided where employees or equipment are permitted to cross over excavations.

- 6 feet Oregon - when walking over trenches
- 4 feet Washington - when walking over trenches

All remotely located excavations must be barricaded, covered, or backfilled. pedestrians must be protected from all excavations and trenches

Egress

No more than 25 feet of travel to a ladder or ramp

Fall protection for workers in the trench is 10 ft WA and 6 ft Federally

Fall protection is not required for persons directly involved in the excavation process (foreman; signal person; employee hooking on pipe or other material; grade person; state, county, or city inspectors; engineer or other professional conducting a QA inspection)

Affected Area is the distance away from the edge of an excavation equal to the depth of the excavation up to a maximum distance of 15 ft. Affected area starts at 10 feet.

Protection from hazards associated with water accumulation

- Protection against cave-in
- Water removal (pumping)
- Run-off protection
- Consider temporary shut-off of water lines

Protection of employees from loose rock or soil

- Scaling
- Protective barriers
- Placing material at least 2' from edge
- No work on slopes above workers

Protection from cave-in requires a systematic approach including:

- Soil classification
- Protective systems
- Inspection
- Employee training

Spoils piles are too placed 2 feet or more away from trench if no protection

Keep equipment ideally same distance as trench if no protection Debris kept cleared from work areas

Soil Classification

Soil Classification (Type A,B,or C) determines construction of protective system:

- Type A means: Cohesive soils with an unconfined compressive strength of 1.5 tons per square foot (tsf) or greater. Examples of cohesive soils are: clay, silty clay, sandy clay
- Type B means: Cohesive soil with an unconfined compressive strength greater than 0.5 tsf but less than 1.5 tsf. Some examples are: granular soils including angular gravel, silt, silt loam, sandy loam or previously disturbed soils
- Type C means: Cohesive soil with an unconfined compressive strength of 0.5 tsf or less. Examples include: gravel, and sand. Also included may be submerged soil or soil from which water is freely seeping, and submerged rock that is not stable.

Classification of the deposits is to be based on the results of at least one visual and one manual analysis. These tests must be conducted by a Competent Person.

Visual Test

Soil that is primarily composed of fine-grained material is cohesive material. Soil composed primarily of coarse-grained sand or gravel is granular material.

Observe soil as it is excavated. Soil that remains in clumps when excavated is cohesive. Soil that breaks up easily and does not stay in clumps is granular

Layered System

In a layered system, the system shall be classified in accordance with its weakest layer. However, each layer may be classified individually where a more stable layer lies under a less stable layer.

Manual Test

Plasticity and Pat Test

Mold a moist or wet sample of soil into a ball and attempt to roll it into threads as thin as 1/8 inch in diameter. Cohesive soil can be successfully rolled into threads without crumbling. If at least a 2 inch length of 1/8 inch thread can be held on one end without tearing, the soil is cohesive.

Spread a 1/8 or 1/4 inch thick sample of wet soil on the palm of the hand. Wipe the surface of the sample with a finger to remove visible water. With the palm facing up, slap the back of the hand moderately 5 to 10 times. If water rises to the surface of the sample (surface will appear shiny), then the soil is mostly cohesion less silt or sand. If no water appears, then the soil is mostly cohesive clay.

Manual Test – Dry Strength

Fissured clay, when dry, falls into clumps which break up into smaller clumps on its own or with some force. Smaller clumps, though, are hard to break up.

Unfissured soil, when dry, can be broken up into clumps which do not break into smaller clumps with pressure. The soil can only be broken with great difficulty. There are also no signs of fissuring on the trench wall or around the area adjacent to the trench.

Granular soil, when dry, crumbles on its own or with some force into individual grains or fine soil.

Manual Test – Thumb Penetration

The thumb penetration test can be used to estimate the unconfined compressive strength of cohesive soils. This test should be conducted on an undisturbed soil clump as soon as practical after excavating to reduce the chance of air drying the sample. If later the trench is exposed to moisture (rain, flooding, etc.), the soil classification must also be changed

- Type A soils can be readily indented by the thumb. However, they can be penetrated by the thumb only with very great effort.
- Type B soils can be readily indented by the thumb, however it requires effort.
- Type C soils can be easily penetrated several inches by the thumb and can be molded by light finger pressure.

Manual Test – Drying Test

The drying test can show the difference between fissured cohesive soils, unfissured cohesive soils, and granular material. Obtain an undisturbed sample of soil approximately 1 inch thick and 6 inches in diameter.

If the sample develops cracks as it dries, fissures are indicated.

Break up samples by hand that dry without cracking. If much force is necessary to break a sample, the soil is cohesive. This soil can be classified as unfissured cohesive material and the unconfined compressive strength should be tested.

If a sample breaks easily by hand, it is either fissured cohesive or a granular material.

Protective Systems

Required unless:

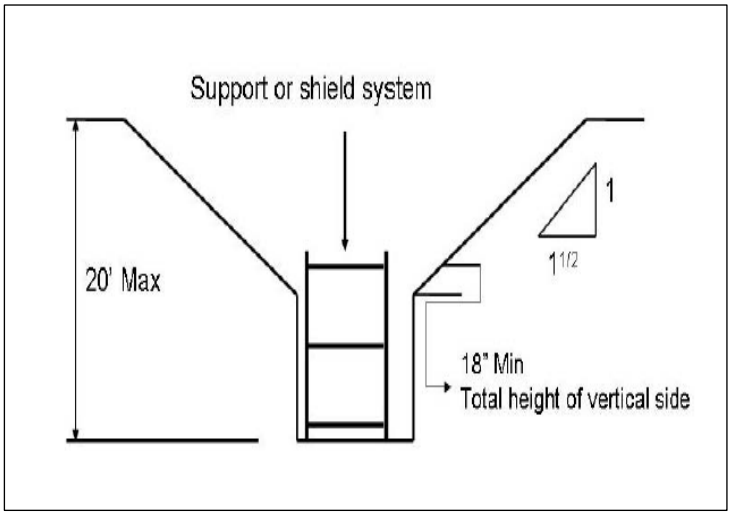
- Excavation in stable rock
- Excavation less than 5' (4 feet for WA) and examination by Competent Person determines no potential for cave-in

Options:

- Sloping and benching
- Shoring/sheet piling/ shielding (e.g.trench boxes)
- Designed by P.E. if deeper than 20'

Maximum Allowable Slope

- For Stable Rock is vertical (90)
- For Type A soil is 3/4:1 (53)
- For Type B soil is 1:1 (45)
- For Type C soil is 11/2:1 (34)



Shoring

- Securely connected
- Employees clear of area under shields during installation
- Installed to prevent movement
- Must protect employees while entering excavation

Protective systems

Trench Box- does not prevent a collapse of soil but provides protection if a collapse occurs.

Best practice is to backfill ¼ to 1/3 of box height or secure from displacement. Also provide protection at ends of the box

Inspect and maintain box in accordance with manufacturer's guidelines.

Speed Shoring- prevents sides of excavation from caving in by putting force on wall of excavation. End protection is not required.

Excavation Inspections

Daily Inspections of ALL excavations by Competent Person

Start of shift, as needed, following rainstorms or other hazard-increasing event

- Possible cave-ins
- Protective system failure
- Water accumulation
- Hazardous atmospheres

Competent person has authority to remove workers from the excavation

Public Safety

Walkways or bridges with standard guardrails must be provided where pedestrians are needing to cross over excavations

All remotely located excavations must be barricaded, covered, or backfilled.

Traffic control methods must have a certified flagger onsite. Only a certified flagger can control traffic and pedestrians

Excavation Rescue

1. Call 911 immediately. Know the address of the site.
2. Be clear if this is a trench rescue which involves an employee buried, or if it is an employee that has suffered an injury and the employee needs help to be brought out of the trench and/or medical assistance. If 911 is not clear on what type of rescue, it will delay the dispatch of the technical trench rescue team.
3. DO NOT TRY TO PERFORM A RESCUE IN AN UNSTABLE TRENCH YOURSELF. ONE VICTIM IS ENOUGH.
4. Do what you can to protect the victim from secondary cave in, this may mean installing additional shoring, using an excavator to hold back a secondary cave in.
5. Shut off all equipment. Stop traffic and any activities that may cause vibrations in the affected area to prevent further caving.
6. Make an analysis of what equipment might be needed for the rescue team and get it at the ready or start making the needed calls to other projects or the shop to get it delivered.
7. Send out a worker or workers to help direct the rescue team into the site.
8. Designate one person to assist the Incident Commander.

Most importantly, Trench Rescues are rarely successful. Therefore, we want to eliminate the need for the rescue in the first place.

Chapter 14

Fire Prevention

General Requirements

Fire Protection Program

Access to fire fighting equipment at all times

Conspicuously located fire fighting equipment

Periodic Inspection and regular maintenance of fire fighting equipment

A fire Extinguisher rated 2A or higher for every 3,000 square feet of combustible building area. Travel distance from any point to the nearest extinguisher shall not exceed 100 feet.

A 55-gallon open drum of water and two fire pails or a garden-type hose with ½ inch diameter and output of 5 gallons per minute can be used as a substitute for a 2A Fire Extinguisher.

You must have a 10B or greater rated Fire Extinguisher within 50 feet of wherever more than 5 gallons of flammable or combustible liquids or 5 pounds of flammable gas are being used on a jobsite. Except for vehicle fuel tanks.

Appropriate Use

- Alarm has been sounded
- Building has been evacuated
- Fire is small and confined
- You can fight the fire with your back toward an escape route
- The extinguisher matches the fire type
- The extinguisher works effectively
- You are properly trained in the use of the extinguisher
- You are confident you can put the fire out

Inappropriate Use

- The fire is large and has grown beyond its original confined space
- Your escape path is threatened
- You are not sure if you have the correct type of fire extinguisher
- Smoke and noxious fumes
- Smoke and fumes cause unconsciousness
- Death may result

PASS

- Hold the extinguisher upright
- Pull the pin
- Aim at the base of the fire
- Squeeze the handle
- Sweep the base of the fire

- Do not aim high at the flames

Prevention

- Keep work areas clean and clutter-free
- Know how to handle and store chemicals
- Know what you are expected to do in an emergency
- Know about the chemicals you work with
- Become familiar with emergency action plan for fires
- Combustion engines, sources of ignition, and exhausts shall be kept at a 6 foot distance from fuels and combustibles.
- Smoking shall be prohibited at or near operations that constitute a fire hazard by means of posting signs conspicuously.
  "No Smoking or Open Flames"
- Nothing shall be built or placed that will interfere with any means of exit.

Open Yard Storage

- Combustible materials shall not be stacked higher than 20 feet.
- Driveways between combustibles shall be at least 15 feet wide.
- Driveways shall be spaced to allow for a maximum 50 by 150 foot grid system.
- Yard shall be kept free from accumulation of unnecessary combustibles.
- Weeds and grass shall be kept low.
- Regular procedures for clean-up of area must be provided.

Indoors

- Storage cannot interfere with exits
- All materials must be stored with due regard to their fire characteristics
- Clearance of 36 inches shall be maintained from top of storage stacks to sprinkler deflectors
- Clearance of 24 inches shall be maintained around paths of travel to exits.

Flammable Liquids

- Must be stored in metal, safety-rated cans or DOT approved containers when in quantities of 5 gallons or less.
- Cannot be stored in areas used as exits or stairways.
- Containers must be legibly marked. For containers with 50 gallon capacity or more, signage/ label must be made to indicate contents with 3 inch minimum height. Post at both discharge valve and fill point.

Chapter 15

Asbestos and Lead Awareness

A naturally occurring mineral that is mined from the ground. Asbestos containing materials may only be removed by certified and trained workers

2 hour awareness training is required for those who may contact asbestos but do not disturb asbestos.

Types of Asbestos:

- Chrysotile – White or Grey 95% of what is used
- Amosite - Brown 2-4% of what is used
- Crocidolite – Blue 1% or less of what is used
- Tremolite
- Actinolite
- Anthophylite

Uses of Asbestos:

- Fire Proof
- Insulator
- Binder good tensile strength
- Friction resistant
- Chemical resistant
- Electrically non-conductive
- Acoustical characteristics
- Indestructible

Fibers that become airborne can take as long as 80 hours to settle 9 feet and fibers are microscopic. Materials that contain more than 1% asbestos.

History

4000 BC Asbestos used for wicks in lamps and candles. The substance was known as "asbestos", meaning inextinguishable or unquenchable.

2000-3000 BC Embalmed bodies of Egyptian pharaohs were wrapped in asbestos clothes to offset the ravages of time.

2500 BC Used in Finland to strengthen clay pots.

800-900 Anecdotal evidence of Charlemagne's table cloth being made from woven asbestos.

1000 Mediterranean’s used Chrysotile from Cyprus and Tremolite from upper Italy for the fabrication of cremation cloths, mats and wicks for temple lamps.

1300-1400 Marco Polo visited an asbestos mine in China in the latter half of the 13th Century. He concluded that asbestos was a stone and laid to rest the myth that asbestos was the hair of a woolly lizard.

Early 1700's Evidence that asbestos papers and boards were made as early as 1700 in Italy.

1712 Chrysotile mined in Russia during the reign of Peter the Great.

1724 Benjamin Franklin brought a purse made of asbestos to England. The purse is now in the Natural History Museum.

1805 Blue asbestos (Crocidolite) first discovered in Orange (South Africa) and was originally named "Wool stone".

1828 The first known US patent issued for asbestos insulating material used in steam engines.

1850 Chrysotile first discovered in Quebec, Canada at the Thedford mines.

Circa 1853 Asbestos helmet and jackets worn by Parisian Fire Brigade.

1860's Packings and gaskets were produced, as mixtures of asbestos and organic fibrous materials.

1866 Moulded lagging material made from water glass and asbestos.

1866 Italian asbestos industry based on Tremolite asbestos dates back to 1866.

Early 1870'sFounding of large asbestos industries in Scotland, Germany and England with the production of "asbestos boards",

1870's The "modern" asbestos industry commenced in Canada and USSR, when large deposits of Chrysotile were extensively exploited.

1880 The American asbestos industry is founded with the use of Italian asbestos to manufacture asbestos paper and board.

1886 Asbestos pipe lagging materials, based on 85% magnesia, were developed.

1896 First asbestos brake linings were made by Ferodo Limited in England. Made by impregnating woven asbestos brake bands with resin.

1897 Viennese physician wrote than emaciation and pulmonary problems left no doubt that (asbestos) dust inhalation was the cause.

1898 England, Lady Inspectors of factories wrote regarding the asbestos manufacturing processes ".... on account of their easily demonstrated danger to the heath of the workers, and because of ascertained cases of injury to bronchial tubes and lungs medically attributed to the employment of the sufferers".

1899 First patent for the manufacture of asbestos cement sheet in Germany.

1900 Initially patented in 1896, first high pressure asbestos gaskets made by Klinger in Austria.

1900 Commencement of mining of Anthophylite in Finland.

1906 Asbestos brake linings manufactured in the USA.

1907 Amosite (brown asbestos) discovered in Transvaal, South Africa. The word Amosite derived from an acronym of "Asbestos Mines of South Africa" from the Amosa mine.

1913 First asbestos pipes developed in Italy.

1915 Asbestos brake linings manufactured in Germany

1919 Standard corrugated sheet introduced in Australia by Hardies.

1920's Large asbestos companies experimented on ways of weaving asbestos. Succeeded, but Chrysotile and Crocidolite were the only fibers to be woven commercially. Crocidolite being almost exclusively used for manufacture of asbestos mattresses for steam trains.

1931 Asbestos industry regulations were passed in the UK to address concerns that asbestos exposure, particularly among textile factory workers led to lung damage.

1939 In the film 'The Wizard of Oz', the Wicked Witch of the West appeared on a broom made of asbestos.

1939-1945 Wartime paraphernalia including fireproof suits and parachute flares contained asbestos.

1945-1975 Post-war construction projects relied heavily on the use of asbestos reaching an all-time high in 1973.

1960s Health concerns began to surface in the US and UK after studies revealed that low levels of asbestos exposure could be more dangerous than previously thought

1990s The solid fuel boosters of the Space Shuttle are insulated with asbestos. One of the few remaining current uses.

Asbestos Containing Material

Thermal Systems Insulation (TSI)
Aircell sectional pipe insulation
Magnesium calcium silicate block sectional pipe insulation
Mudded elbows
HVAC ductwork
Tank and boiler insulation

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- Magnesium calcium silicate block sectional pipe insulation
- Mudded elbows
- HVAC ductwork
- Tank and boiler insulation

Surfacing Materials (Sprayed-on or Troweled-on)

- Acoustical plaster on ceilings
- Spray on popcorn decorative ceilings
- Fireproofing of structural members
- Asbestos paper under floors and walls

Miscellaneous
- Flooring and mastics
- Roofing products
- Gaskets
- Ceiling tiles
- Window putty and caulking
- Adhesives
- Cement Asbestos Board

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Building Owners must have a survey of buildings to test for presence and location of ACM prior to maintenance, renovation or demolition activities (any type of disturbance). Notify all affected parties that may potentially disturb materials example= contractors

Health Effects

Pliny the Younger 1000BC- Slaves in mine

British Labor Inspectorate 1898-Banned asbestos dust

Asbestosis early 1900's

Cancer links first suspected mid 1930's

Mesothelioma – Causal link made in 1965

Dose Response Relationship- As the length of time one who is exposed increases the greater the effects of the exposure will increase

Latency Period
- Is the time between the first exposure and the onset of symptoms or disease
- In the case of asbestos exposure the latency period is from 10-30 years

Acute – short term exposure of seconds, minutes, or hours
Chronic – long duration, prolonged or repeated exposure

Medical Surveillance

Medical history questionnaire
Physical exam
Chest X-ray

Pulmonary function test

Employer is required to maintain all medical records. Minimum of employment plus 30 years

Worker protection regulations
Environmental protection regulations
Puget Sound Clean Air Agency Regulations

Occupational Safety and Health Act – Washington Industrial Safety and Health Act establishes a permissible exposure limit of – 0.1 f/cc or 100,000/ m^3

OSHA/ LnI Requires

- Engineering controls
- Work practices
- Protective clothing and respirators to reduce exposure
- Worker exposure monitoring with air monitoring and medicals

Classes of Asbestos Work

Class I- Thermal system insulation or surfacing ACM removal
Class II All other ACM (miscellaneous) removal of floors, roofs, siding, ceiling tiles, cement asbestos board, wiring, transite pipe, etc. Not TSI or surfacing
Class III- Disturbance or removal of small amount of ACM for purpose of maintenance or repair only. Must be able to fit in one 60”x 60” glove bag
Class IV- Custodial debris cleanup less than 1 square foot. Contact only, no disturbance

2 – Hour Asbestos Awareness workers can only perform Class IV work

Puget Sound Clean Air Agency

Requires removal prior to demolition
Requires adequate wetting of materials at all times during removal
Notification to agency
Proper labeling, shipping and disposal

PPE

Proper respirator
Proper protective clothing
Proper hygiene facilities – decontamination area
No dry sweeping
Wet methods
Use Only HEPA filtered vacuums
Prompt cleanup of waste and debris

Full protection during assessment
Initial air monitoring

Has to be representative of actual work activities

What is a Release?

Damage and debris caused from an unintentional disturbance

Immediate actions steps to take in the event of a release
- Do not disturb material
- Communicate to others in the area
- Minimize access
- Contact those qualified to provide emergency cleanup

LEAD

Health Hazards of Lead

- Headaches, tiredness and insomnia
- Loss of appetite
- Stomach pain
- Pain, weakness or twitching in your muscle
- Reduced sex drive
- Birth defect
- Kidney damage
- Constipation
- Weight loss
- Muscle and joint pain
- Permanent brain and nerve damage
- Lead is harmful to the fetus of pregnant women

Children are the most susceptible to lead. The amounts harmful to children are much lower than for adults
- Reduced attention span/ Hyperactivity
- Slowed growth
- Behavior & learning problems
- Hearing Problems.

There is no real “safe” amount of lead. The airborne permissible exposure limit is 50μg/m3
The amount considered safe in the blood is 40 μg/dl
Lead gets into your body by:

- Inhaling lead dust or lead spray paint, lead fumes from welding or burning on lead based paint
- Ingesting lead dust on your hands from eating, drinking or smoking or applying makeup

Products Containing Lead

- Soil
- Lead fishing weights
- Car weights for tire balancing
- Reloading bullets
- Dust
- Drinking water
- Gas
- Abrasive Blast Media
- Used as a Sweetener for Wine in Roman Empire
- Air
- Food
- Folk-cure medications.
- Vinyl miniblinds
- Pottery
- Leaded glass
- Plumbing and Soldering Banned in 1988
- Grecian formula for men

Ethnic home remedies:
“Greta” & “azarcon” for upset stomachs.
“pay-loo-ah” a red powder used to treat skin rashes

The following products used or items found on this worksite contain lead:

- Interior painted surfaces
- Exterior painted surfaces
- Interior and exterior doors and jambs
- Interior and exterior trim for windows
- Painted wood trim both interior and exterior

You may be exposed to lead at this jobsite in the following activities or locations:

- Demolition of Painted Surfaces Interior and Exterior
- Preparation of Surfaces for Repainting
- Removal of Painted Doors or Windows
- Demolition Required for Seismic Upgrade
- Soils Previously Contaminated
- Bridge painting
- Removing lead-based paint on old buildings or houses
- Grinding or sandblasting lead paint on metal structures
- Cutting or removing lead pipe in old buildings

Airborne Action Level 30 ug/m3 8-hr TWA
At this Level Training is required and Blood Tests required to be offered. Required if exposed for more than 30 days a year

Airborne Permissible Exposure Limit 50 ug/m3 8-hr TWA

Respiratory protection may be required based on the work activity
The type of respirator will depend on your exposure Use of Respirators

- Respirators must be worn at all times when the amount of lead in the air is above the PEL.
- Respirators must fit properly to prevent leaks.
- You must have a respirator medical evaluation before you wear a respirator.
- You must have a respirator fit-test before you wear a respirator.
- You can’t have a beard when you wear a tight-fitting respirator.
- We will train you on how to use your respirator.

What and When is Medical Monitoring Required

Anyone who is exposed to lead above the “airborne action level” must be provided blood tests. Offered for those exposed more than 1 day and required for more than 30 days exposure per year. If the amount of lead in your blood is more than 40, we will send you for a medical exam.

Blood tests will be routinely done if you are exposed to lead for 30 or more days per year. This will occur every 2 months until six months and then every 6 months after unless your blood lead level exceeds 40 ug/dl.

Medical Removal for Lead Exposure

- If the amount of lead your blood is above 50, you will be temporarily removed from the lead job.
- You can't return to that job until your blood level drops below 40.
- Your blood must be tested monthly until the lead level drops below 40.
- Medical removal is required is because of the serious health effects of lead.

Your body will gradually rid itself of lead over time. You do not lose any earnings, seniority or benefits and you can return to former job status.

Best Practices:

- Don't eat, drink or smoke in the area where there is lead
- When you take a break, wash your hands before eating drinking or smoking
- Always use separate protective clothing and boots
- Street Cloths need to be stored in a clean separate place
- Always make sure clothing used in the work area is laundered at work
- Do not wear any clothing home that has been exposed to lead
- Work Practices to Control or Reduce Lead Exposure
- Do not remove dust by blowing with air or shaking, only remove by hepa vac and then laundering
- Remember to always wash your hands before eating, smoking, drinking or applying makeup
- Always shower at the end of the shift
- Don't dry sweep or blow down lead dust unless you have a ventilation system designed to remove the airborne dust
- Whenever feasible always use a hepa vacuum to remove dust and debris
- Whenever possible use wet methods when grinding or sanding to reduce lead exposure
- Use natural or mechanical ventilation
- Use vacuum attachments for grinders and sanders when possible

"Chelation" is the taking of certain drugs that help rid the body of lead. It is a form of treatment for high lead levels in the body. It is not allowed on a routine basis. Only a doctor can authorize and supervise lead Chelation.

Medical and Air Sampling Records

- You have the right to see any of your medical records related to lead
- You also have the right to see results of air sampling for lead

16

Job Hazard Analysis

A technique that focuses on job tasks as a way to identify hazards before they occur. It focuses on the relationship between the worker, the task, the tools, and the work environment. Identifies the steps to eliminate or reduce hazards to an acceptable risk level.

What jobs need a JHA?

- Jobs with the highest injury or illness rates
- Jobs in which one simple human error could lead to a severe accident or injury
- Jobs that are new to your operation or have undergone changes in processes and procedures
- Jobs complex enough to require written instructions.

Why is a JHA is Important?
You can help prevent workplace injuries and illnesses by looking at your workplace operations by establishing proper job procedures, and ensuring that all employees are trained properly.

- Conduct a preliminary job review.
- List, rank, and set priorities for hazardous jobs
- Outline the steps or tasks
    - What can go wrong?
    - What are the consequences?
    - How could it arise?
    - What are other contributing factors?
    - How likely is it that the hazard will occur?

Questions to ask.

- Where it is happening (environment)
- Who or what it is happening to (exposure)
- What precipitates the hazard (trigger)
- The outcome that would occur should it happen (consequence), and
- Any other contributing factors.

Breakout

Worker reaches into metal box to the right of the machine, grasps a 15-pound casting and carries it to grinding wheel. Worker grinds 20 to 30 castings per hour. Identify hazards and write a JHA

Risk Assessment Analysis (RAA)

Risk/Activity/Work Task:	Overall Risk Assessment Code (RAC) (Use highest code)	**L**
Project Location:	**Risk Assessment Code (RAC) Matrix**	
Contract Number:	**Severity**	**Probability**
Date Prepared:		Frequent / Likely / Occasional / Seldom / Unlikely
Prepared by (Name/Title):	Catastrophic	E / E / H / H / M
	Critical	E / H / H / M / L
Reviewed by (Name/Title):	Marginal	H / M / M / L / L
	Negligible	M / L / L / L / L
Notes: (Field Notes, Review Comments, etc.)	Step 1: Review each **"Hazard"** with identified safety **"Controls"** and determine RAC (See above)	
	"Probability" is the likelihood to cause an incident, near miss, or accident and identified as: Frequent, Likely, Occasional, Seldom or Unlikely.	**RAC Chart**
	"Severity" is the outcome/degree if an incident, near miss, or accident did occur and identified as: Catastrophic, Critical, Marginal, or Negligible	**E = Extremely High Risk**
		H = High Risk
	Step 2: Identify the RAC (Probability/Severity) as E, H, M, or L for each "Hazard" Annotate the overall highest RAC at the top of AHA.	**M = Moderate Risk**
		L = Low Risk

Identified Risk	Hazards	Controls	RAC

Controls To Be Used	Training Requirements	Inspection Requirements

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Electrical Safety

About 5 workers are electrocuted every week and causes 12% of young worker workplace deaths. It takes very little electricity to cause harm and is a significant risk of causing fires.

There are four main types of electrical injuries:
Direct:

- Electrocution or death due to electrical shock
- Electrical shock
- Burns

Indirect - Falls

An electrical shock is received when electrical current passes through the body.

You will get an electrical shock if a part of your body completes an electrical circuit by…

- Touching a live wire and an electrical ground, or
- Touching a live wire and another wire at a different voltage.

Severity of the shock depends on the path of current through the body, amount of current flowing through the body (amps) and duration of the shocking current through the body,

LOW VOLTAGE DOES NOT MEAN LOW HAZARD

Currents above 10 mA* can paralyze or "freeze" muscles. Currents more than 75 mA can cause a rapid, ineffective heartbeat -- death will occur in a few minutes unless a defibrillator is used 75 mA is not much current – a small power drill uses 30 times as much

* mA = milliampere = 1/1,000 of an ampere

Burns are the most common shock-related injury. Usually occurs when you touch electrical wiring or equipment that is improperly used or maintained. Typically occurs on hands and is a very serious injury that needs immediate attention.

Electrical accidents are caused by a combination of three factors:

- Unsafe equipment and/or installation,
- Workplaces made unsafe by the environment, and
- Unsafe work practices.

Control:

- Use guards or barriers
- Replace covers
- Guard live parts of electric equipment operating at 50 volts or more against accidental contact
- Junction boxes, pull boxes and fittings must have approved covers

- Unused openings in cabinets, boxes and fittings must be closed (no missing knockouts)

Overhead Power Lines are usually not insulated. Examples of equipment that can contact power lines:

- Crane
- Ladder
- Scaffold
- Backhoe
- Scissors lift
- Raised dump truck bed
- Aluminum paint roller

Stay at least 10 feet away. Post warning signs and assume that lines are energized. Use wood or fiberglass ladders, not metal. Power line workers need special training & PPE.

750 V to 50 kV	10
50 kV to 200 kV	15
200 kV to 350 kV	20

Inadequate Wiring Hazards

- **Hazard** - wire too small for the current
- **Example** - portable tool with an extension cord that has a wire too small for the tool
  - The tool will draw more current than the cord can handle, causing overheating and a possible fire without tripping the circuit breaker
  - The circuit breaker could be the right size for the circuit but not for the smaller-wire extension cord
- Wire used depends on operation, building materials, electrical load, and environmental factors
- Use fixed cords rather than flexible cords
- Must be 3-wire type and designed for hard or extra-hard use
- Use the correct extension cord
- Cords can be damaged by:
  - Aging
  - Door or window edges
  - Staples or fastenings
  - Abrasion from adjacent materials
  - Activity in the area
- Improper use can cause shocks, burns or fire

Best Practice:

- Insulate live wires
- Check before use
- Use only cords marked for hard or extra-hard usage
- Use only cords, connection devices, and fittings equipped with strain relief
- Remove cords by pulling on the plugs, not the cords

- Cords not marked for hard or extra-hard use, or which have been modified, must be taken out of service immediately
- Tools plugged into improperly grounded circuits may become energized
- Broken wire or plug on extension cord

DO NOT use flexible wiring where frequent inspection would be difficult or where damage would be likely.

Flexible cords must not be . . .
- run through holes in walls, ceilings, or floors;
- run through doorways, windows, or similar openings (unless physically protected);
- hidden in walls, ceilings, floors, conduit or other raceways.

- Ground power supply systems, electrical circuits, and electrical equipment
- Frequently inspect electrical systems to insure path to ground is continuous
- Inspect electrical equipment before use
- Don't remove ground prongs from tools or extension cords
- Ground exposed metal parts of equipment
- Protects you from shock
- Detects difference in current between the black and white wires
- If ground fault detected, GFCI shuts off electricity in $1/40^{th}$ of a second
- Use GFCI's on all 120-volt, single-phase, 15- and 20-ampere receptacles, or have an assured equipment grounding conductor program.

Program must cover:
- All cord sets
- Receptacles not part of a building or structure
- Equipment connected by plug and cord

Program requirements include:
- Specific procedures adopted by the employer
- Competent person to implement the program
- Visual inspection for damage of equipment connected by cord and plug

Hazards may result from:
- Too many devices plugged into a circuit, causing heated wires and possibly a fire
- Damaged tools overheating
- Lack of over current protection
- Wire insulation melting, which may cause arcing and a fire in the area where the overload exists, even inside a wall
- Automatically opens circuit if excess current from overload or ground-fault is detected – shutting off electricity
- Includes GFCI's, fuses, and circuit breakers
- Fuses and circuit breakers are <u>over current</u> devices.

Power Tool Requirements

- Have a three-wire cord with ground plugged into a grounded receptacle, or
- Be double insulated, or
- Be powered by a low-voltage isolation transformer
- Inspect tools before use
- Use the right tool correctly
- Protect your tools
- Use double insulated tools

Tool Safety Tips

- Use gloves and appropriate footwear
- Store in dry place when not using
- Don't use in wet/damp conditions
- Keep working areas well lit
- Ensure not a tripping hazard
- Don't carry a tool by the cord
- Don't yank the cord to disconnect it
- Keep cords away from heat, oil, & sharp edges
- Disconnect when not in use and when changing accessories such as blades & bits
- Remove damaged tools from use

Clues Electrical Hazards Exists

- Tripped circuit breakers or blown fuses
- Warm tools, wires, cords, connections, or junction boxes
- GFCI that shuts off a circuit
- Worn or frayed insulation around wire or connection
- Apply locks to power source after de-energizing
- Tag deactivated controls
- Tag de-energized equipment and circuits at all points where they can be energized
- Tags must identify equipment or circuits being worked on

To protect workers from electrical shock:

- Use barriers and guards to prevent passage through areas of exposed energized equipment
- Pre-plan work, post hazard warnings and use protective measures
- Keep working spaces and walkways clear of cords
- "Bunny Hop"
- Use special insulated tools when working on fuses with energized terminals
- Don't use worn or frayed cords and cables
- Don't fasten extension cords with staples, hang from nails, or suspend by wire

Preventing Electrical Hazards

- Plan your work with others
- Plan to avoid falls
- Plan to lock-out and tag-out equipment

- Remove jewelry
- Avoid wet conditions and overhead power lines
- Damaged insulation, equipment, or tools can expose you to live electrical parts.
- Improperly grounded metal switch plates & ceiling lights are especially hazardous in wet conditions.
- Wet clothing, high humidity, and perspiration increase your chances of being electrocuted.

PPE

- Proper foot protection (not tennis shoes)
- Rubber insulating gloves, hoods, sleeves, matting, and blankets
- Hard hat (insulated - nonconductive)
- Use and test GFCI's
- Check switches and insulation
- Use three prong plugs
- Use extension cords only when necessary & assure in proper condition and right type for job
- Use correct connectors

Train employees working with electric equipment in safe work practices, including:

- Deenergize electric equipment before inspecting or repairing
- Using cords, cables, and electric tools that are in good repair
- Lockout / Tagout recognition and procedures
- Use appropriate protective equipment

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Fall Protection Training

2 or 3 deaths and 130 serious injuries occur each year in Washington from falls from roofs.

It is easy to forget where the roof edge is when you are concentrating on your work.

It is nearly impossible to stop or catch yourself if you fall.

Most people do not have the strength to stop a fall greater than two feet.

It takes half a second to react to fall. In that time you will fall 4 feet.

When used properly, fall protection will prevent serious injury or death.

A large number of injuries in roofing are falls from ladders.

Ladders must be stabilized and extend at least 3 feet above the roof edge.

Both hands must be free when climbing a ladder.

When Accessing upper levels, you must be able to step on to the deck 6' in from the edge if roofing related or leading edge work.

Competent Person means one who is capable of identifying existing and predictable hazards, or working conditions which are unsanitary, hazardous, or dangerous to employees, and who has the authorization to take prompt corrective measures to eliminate the hazards.

Affected area- is the distance away from the edge of an excavation equal to the depth of the excavation up to a maximum distance of 15ft.

Floor hole- 2inch up to 12 inches

Floor opening- 12 inches or more where a person may fall through

Walking or working surfaces-

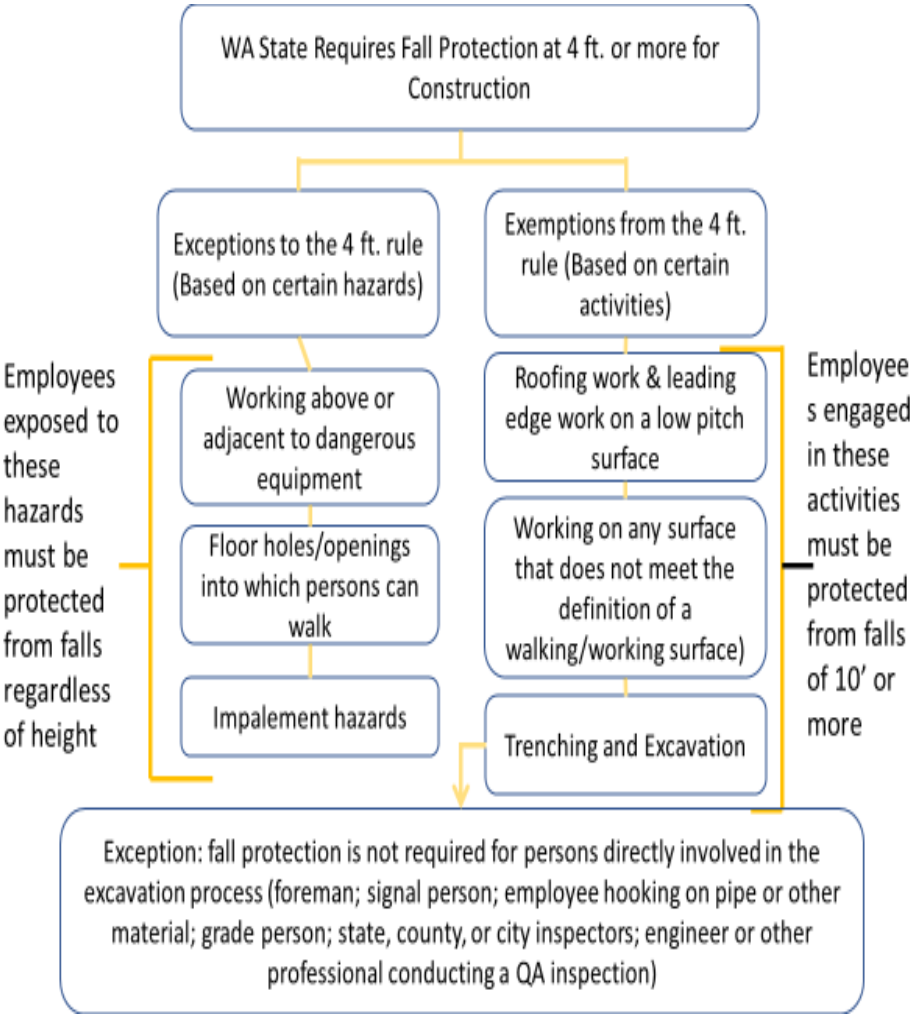
means any area including, but not limited to, floors, a roof surface, bridge, the ground, and any other surfaces through which workers can pass or conduct work.

A walking /working surface does not include vehicles or rolling stock on which employees must be located in order to perform their job duties. Rolling stock protection at 4 feet if possible.

Fall protection during form and rebar work. When exposed to a fall height of 4 feet or more, employees placing or tying reinforcing steel on a vertical face are required to be protected by personal fall arrest systems, safety net systems, or positioning device systems.

A leading edge is the advancing edge of a floor, roof or formwork as additional sections are placed, formed or constructed. The edge of a finished roof is not a leading edge.

A plumber installing a pipe boot is NOT exempt from fall protection at 4 feet as it is not leading edge work



Exceptions to fall protection

- Initial set up of fall protection systems
- Take down of fall protection systems
- Inspections which do not require work to be performed

Employees may still use fall protection if risk is high

Low pitched roofs and fall protection

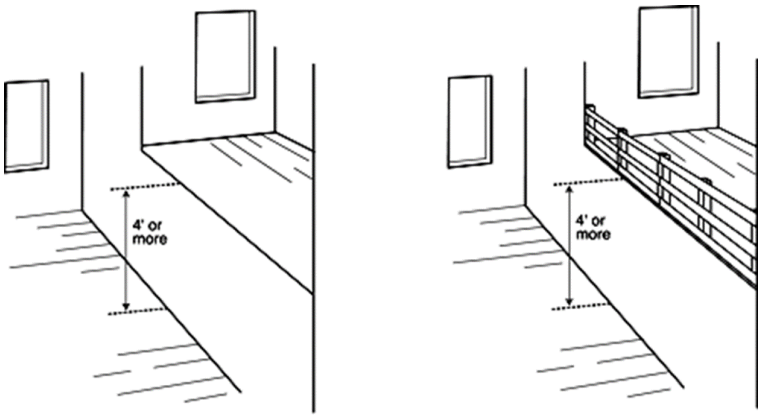
A roof with a slope of 4:12 or less is a low-pitched roof.

Fall protection is required on low-pitched roofs where the fall distance is 6 feet or more such as at the gable end.

Fall protection is not normally required on low-pitched roof edge work below 6 feet.

Some roofs are considered "hazardous slopes" when they are steep, slippery or both.

When any roof is so steep or slippery that an uncontrolled fall would likely happen, fall protection is required at 4 feet.



OPEN FLOOR (Unguarded) GUARDED FLOOR

Elimination: Remove the hazard from work areas or change task, process, controls or other means to eliminate the need to work at heights and subsequent exposure to fall hazards

Prevention (traditional or same-level barrier): isolate and separate fall hazards from work areas by erecting same level barriers such as guardrails, walls, covers or parapets;

Personal Protective Systems and Equipment: Use of fall protection systems, including restraint, positioning or personal fall arrest

Administrative Controls: Introduce new work practices that reduce the risk of falling from heights, or to warn a person to avoid approaching a fall hazard (i.e. warning systems, warning lines, audible alarms, signs or training of workers to recognize specific fall hazards).

The warning line is installed six feet from the roof edge at a height of 36-42 inches.

Line is flagged every six feet.

Work outside the safe area requires a safety monitor.

Equipment cannot be used or stored outside safe area.