HAZARD COMMUNICATION TRAINING
4-hour course in accordance with 29 CFR1910.1200
STUDENT MANUAL
This training program was developed for the CPWR - The Center for Construction Research and Training by:

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Hazard Communication Training

4-hour course in accordance with 29 CFR1910.1200

This course is delivered in 10 sections:

1. Course introduction
2. Hazard Communication (Hazcom) standard overview
3. Training requirements
4. Chemical overview
5. Review of common health effects
6. Measurement and exposure limits
7. Hazard Communication systems
8. Controls
9. Spill response
10. GHS and REACH
Section 1: Course Introduction

After completing this course you will be able to:

- Provide a definition for hazard communication
- List three rights workers have under Hazcom
- List three hazardous chemical categories
- List three routes of entry for chemicals
- Give three methods for finding information about chemicals that you use
- List three methods of chemical hazard control
- Contrast an incidental spill vs. an emergency response
- Define GHS and REACH and list one benefit for workers

The primary objective of this course is for you to know why, how and where to find specific hazard information to help you protect yourself from chemical hazards.

What this course will not do

This course will not prepare you to be an emergency responder! While proper Hazcom training will allow workers to clean up “incidental spills” of chemicals in their work area that they are familiar with, they are not allowed to respond to emergency situations.

If you believe you have an emergency situation, follow your employer’s emergency response plan to evacuate the area and notify someone who is authorized to respond. If your employer does not have an emergency response plan, tell your coworkers and get out of the area and notify the first supervisor you can.

Hazcom training will qualify you to find information about chemicals you work in your work area, as well as prepare you to identify spills and releases of hazardous chemicals and to report them to qualified response personnel. Again, if authorized by your employer, you will be qualified to clean up “incidental” spills in your work area. Incidental spill cleanup will be discussed more in Section 9 of this manual.
Don’t risk your life at work!


How much risk are you willing to take on the job to make a living? According to OSHA, no workers should risk their well being since an employer must provide a workplace “...free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees (general duty clause)”. So, if work place hazards are not supposed to be present, why should you take a risk when your employer is legally obligated to remove hazards from the workplace? Let’s conduct a short, small group activity about work hazards and risks.

Activity 1: Sharing your thoughts about occupational health and safety hazards

Time for activity: 10 minutes (5 for group work and 5 for report back)

Objective: The goal of this activity is to share and discuss your experiences related to occupational health and safety with your fellow participants and instructors.

Task: In your groups, work together to discuss and answer the following questions. Select a spokesperson to report back your group’s answers to the class. Try to come to a mutual answer for each of the questions.

1. True or False: There are many laws from different governmental agencies that help to adequately protect me when I work around or with hazardous chemicals. Explain your answer.
2. Agree or Disagree: Working with hazardous chemicals can be risky work but taking risks is part of the job and the compensation I receive outweighs the risks. Explain your answer.

3. Agree or Disagree: Hazardous chemicals are harmful to human health. They are by far the greatest hazard I will face during my work.

4. Name five chemicals that you use at work. Do you know the hazards of these chemicals? Can you list some of the hazards?
Section 2: Hazard Communication (Hazcom) Standard Overview

What is Hazard Communication (Hazcom)?

Hazard communication involves the communication of hazards about chemicals to employees.

Why is this important? Write your answers below. Take no more than 5 minutes.

Why have a Hazcom standard?

Write your answers below. Take no more than 5 minutes.
Hazcom standards help workers:

- Reduce their risks to chemicals
- Avoid dangerous chemicals
- Obtain proper education about chemicals
- Select proper PPE
- Understand basic “incidental spill” response procedures

Chemical use statistics

Chemicals are used in almost every type of workplace. Let’s look at some statistics about chemical use in the workplace. According to OSHA, 32 million workers work with, and are potentially exposed to, one or more chemical hazards. That is a lot of exposed workers! CHEMCATS ® states that there are 54,046,543 chemicals commercially available with 600 new ones introduced each year (Chemical Abstract Service (CAS)). Only 282,904 substances are inventoried or regulated (CHEMLIST ®). Finally, the International Labor Organization states that chemicals account for roughly 22% of all workplace diseases and injuries. As you can see, chemical use in the work environment is very high. If you are not properly trained on the hazards of working with or near chemicals, your health and safety could be in jeopardy.

Why all the fuss over chemicals?

Chemicals can cause explosions, start fires or make a fire burn hotter and faster. Some will burn your skin or even blind you. Others can suffocate you. Chemical exposure may cause or contribute to many serious health effects. Some chemicals can damage organs like the liver and the brain and can affect your ability to have healthy children. A few cause cancer. When you work with a chemical, you will want to know the hazards associated with its use. You have a legal right to this information.

Because of the seriousness of the safety and health effects posed by chemicals, and because many employers and employees know little or nothing about them, OSHA issued the Hazard Communication Standard. The basic goal of the standard is to be sure employers and employees know about work hazards and how to protect themselves; this should help to reduce
the incidence of chemical-based illnesses and injuries. The Hazard Communication Standard establishes uniform requirements to make sure that the hazards of all chemicals imported into, produced in, or used in U.S. workplaces are evaluated, and that this hazard information is transmitted to affected employers and exposed employees.

**The Hazard Communication Standard**

The Hazard Communication Standard, or Hazcom Standard, is an OSHA standard, which means it’s the LAW. It is found in 29 CFR 1910.1200 and 29 CFR 1926.59.

Hazard communication involves the communication of hazards about chemicals to employees. Its main purpose is to make sure employers are giving workers the information about the hazards associated with chemicals found in the workplace. This information includes:

1. The legal exposure limits of chemicals
2. Where to find information about chemicals
3. How to identify chemicals
4. What to do if a chemical is spilled

Some states may have increased protective hazard communication regulations, such as California. California has private employer requirements for chemicals that present reproductive dangers or are known carcinogens. These requirements are defined under proposition 65 which states that employers must notify users if ANY amount of carcinogens, teratogens or mutagens are in a chemical.

Employers and workers covered by an OSHA-approved state safety and health plan should check with their state agency, which may be enforcing standards and other procedures “at least as effective as,” but not always identical to, Federal requirements.

**Major requirements in the Hazcom regulation**

Hazcom starts with manufacturers and importers and requires them to identify the hazards of each chemical. Next, manufacturers, importers and distributors must communicate chemical hazards and protective measures downstream through labels and MSDSs. The remaining requirements fall to the employer to implement.
There are several major requirements in the Hazard Communication regulations:

- Written Hazcom program
- Training workers
- Chemical inventory and control
- MSDS available for hazardous substances in the workplace
- Labeling of hazardous chemicals
- Make required information available

What is a Hazcom Program?

Employers must develop, implement, and maintain at the workplace a written, comprehensive Hazcom program. A program is the employer’s procedure for meeting the requirements of a particular regulation, in this case, the Hazcom regulation. Workers have the right to review the Hazcom program on work time and to ask questions about it! A written hazard communication program ensures that all employers receive the information they need to inform and train their workers properly and to design and put in place worker protection programs. It also provides necessary hazard information to employees, so they can participate in, and support, the protective measures in place at their workplaces.

Often during construction there is more than one employer working on the site at the same time. In that case all employers must provide information to one another about the hazardous chemicals they are using. This sharing of information helps prevent worker exposure to chemical hazards from another employer. One important thing to remember is that the Hazcom standard gives workers the right to information concerning chemicals in their work area, not just ones they work with directly.

This is part of the standard because:

1. Chemicals do not often stay in one place; they can evaporate and reach other workers.
2. There may be an accident that causes workers in the area to be exposed.
3. Your rights involve your work area.
The written Hazcom program must be available at the job site and must include the following information:

• List the hazardous chemicals on the job site
• Explain how the employer will inform workers of hazards associated with non-routine tasks involving hazardous chemicals
• Explain labels and other forms of warning used by the employer
• Explain how the employer will provide material safety data sheets to workers
• Describe the training the employer will use to teach workers about hazardous chemicals

At multiple employer sites, written hazard communication programs must:

• Explain how MSDSs will be provided to other employers
• List the methods employers will use to inform other employers of measures taken to protect workers during normal operating conditions and in foreseeable emergencies
• Explain how employers will inform other employers of the labeling systems being used

Not having a written Hazcom program can cost employers and harm workers.

Failure to have a written Hazcom program was the #1 OSHA cited violation in 2010!

• 1910.1200(e)(1)
• 4,853 citations
• $578,753
Workers have rights under Hazcom!

The Hazcom standard guarantees workers various rights, including:

- To personally receive information regarding hazardous substances to which they may be exposed
- To have sent to their physician or collective bargaining agent information regarding hazardous substances to which they may be exposed
- Protection against discharge or other discrimination due to their exercising of the rights afforded to them pursuant to the provisions of the Hazardous Substances Information and Training Act

When an employer receives a new or revised MSDS

Such information shall be provided to employees on a timely basis, not to exceed 30 days after receipt, if the new information indicates significantly increased risks to, or measures necessary to protect, employee health as compared to those stated on a material safety data sheet previously provided.

What if you have had proper Hazcom training and a chemical that you work with was found to have additional health hazards, such as it became a known carcinogen, and a new MSDS was created? Your employer must take this information and provide it to employees on a timely basis, not to exceed 30 days after receipt. But, now knowing that the chemical causes cancer, what would a “timely basis” mean?

Now that we have covered a basic review of the Hazcom standard, let’s conduct a short, small group activity to familiarize you with your employer’s (or a generic program) Hazcom program.
Activity 2: Investigating your work site’s Hazard Communication Program

Time for activity: 15 minutes (10 for group work and 5 for report back)

Objective: The goal of this activity is to investigate your work site’s Hazcom program. By reviewing your employer’s Hazcom program, you will understand the hazardous chemicals you work with and around. This understanding will help increase your level of safety. This activity will also help you to understand and practice how to “read” a Hazcom program so that you can efficiently retrieve the information of importance to you.

Task: In your groups, work together to discuss and answer the following questions regarding your work site’s Hazcom program. If you do not have a worksite Hazcom program, a generic example of a Hazcom program will be used. A generic hazcom program can be found in Appendix C. Select a spokesperson to report back your group’s answers to the class. Try to come to a mutual answer for each of the questions.

1. Take a few minutes to review the Hazcom program.

2. State on what page and section you will find requirements for MSDSs. Be prepared to state what they are. Discuss what you find there with your group.
3. What does the Hazcom program say about labeling? List some requirements and be able to state where you found them.

4. Does your work site maintain a list of hazardous substances? If yes, where can it be found? If they do not, what do they use in its place?

5. If you have questions regarding the Hazcom program or hazardous chemicals you work with or near, how can you get those questions answered? Be specific.
Section 3: Training Requirements

Training workers is mandatory yet it is often overlooked!

In 2010 failure of adequate Hazcom information and training was the 6th most cited OSHA violation!

- 1910.1200(h)(1)
- 2,501 citations
- $219,479

Employers shall provide employees with effective information and training on hazardous substances in their work area at the time of their initial assignment, and whenever a new hazard is introduced into their work area. In other words, the employer is legally not allowed to let workers work with a chemical they know nothing about!

**Employees must be trained on:**

- The Hazard Communication Standard and its requirements
- Requirements under the training section of the Hazcom regulation
- Any operations in their work area where hazardous substances are present
- Methods and observations that may be used to detect the presence or release of a hazardous substance in the work area
- Physical and health hazards of the substances in the work area
- Measures they can take to protect themselves from these hazards
- The details, location and availability, of their employer’s written Hazcom program
- Special worker rights under the Hazcom Standard

Figure 3. MSDS kept in a hard-to-get-to place.
Training must also cover:

- Hazardous chemicals used in the workplace (general hazard categories)
- Location and availability of MSDSs
- Labeling systems

Workers must also be trained on general hazard categories (corrosives, carcinogens, etc.) of hazardous chemicals used in the workplace. You are not required to receive training on every individual chemical you may work with, but you must receive training that covers the general hazardous categories, since these will all act on you in the same manner.

Section 4: Chemical and Toxicology Overview

As mentioned in the last section, training workers about the different hazard categories is mandatory.

All chemicals are found in one of three forms.

Chemicals, or hazardous materials, come in all forms, shapes and sizes. Recognizing the potential forms of a chemical gives you clues as to how it may pose a danger to you and your coworkers. Chemicals are found in three states: solid, liquid and gas. You can even have a chemical in different states depending on environmental conditions such as pressure and temperature. For example, under normal conditions, water is a liquid between 32º F and 212º F. Below 32º F it is a solid (ice) and above 212º F it is a gas (steam). You can find most of this information on an MSDS or product label, but not always.

Each chemical form can have different “types” or categories. Write an example of a category after each form.

<table>
<thead>
<tr>
<th>Form</th>
<th>Example</th>
</tr>
</thead>
<tbody>
<tr>
<td>Solid</td>
<td>____________________________</td>
</tr>
<tr>
<td>Liquid</td>
<td>____________________________</td>
</tr>
<tr>
<td>Gas</td>
<td>____________________________</td>
</tr>
</tbody>
</table>
Besides determining if a chemical is in a solid, liquid or gaseous state, we can also look at the common forms chemical products come in as the following list shows:

- **Solids**
  - Dusts
  - Aerosols
  - Fibers
  - Fumes
- **Liquids**
  - Vapors
  - Mists
  - Aerosols
- **Gases**
  - Just Gas (also vapor can be placed here)!

The form of a chemical affects how workers interact with it and how it can affect workers.

### Solids

If solids get into the air they could get into your body and harm you! There are many solids that you may be exposed to if you are in construction work. Take a moment to think of all the construction materials you use on the job where “dust” from working with it can get into the air and reach your breathing zone and enter your body. Mixing cement/concrete/mortar/grout, cutting, sanding or grinding any material, even sweeping the floor could create a great deal of dust. By understanding that solid materials that you work with may reach your breathing zone, you are aware of the hazard and can take steps to protect yourself.

Figure 4. Asbestos fibers.

Figure 5. Welding fumes.
Liquids

Liquids can come into direct contact with your skin and be absorbed into your body. Liquids can be sprayed and form mists or evaporate and form vapors which can be inhaled. Mists can settle on your skin and be absorbed or settle and contaminate food or drinks. Any time you use a liquid or gel, your skin and eyes are at risk of exposure. Paints, adhesives and fuels can form vapors and reach your breathing zone.

Gases and Vapors

Gases are chemicals that are in the gas phase at room temperature (70°F). Vapors evaporate from substances that are liquids or solids at room temperature. Gases and vapors enter the body by inhalation and can reach the deep lung.

Some physical properties of chemicals

By understanding some physical properties of chemicals you will better understand how a chemical may “act” in the environment and therefore you will be able to protect yourself. Take vapor density for example. Maybe you are cleaning a mechanical component in a confined space with an organic solvent possessing a high vapor density. You can assume that it would start to settle toward the floor as it evaporates. How would this fact help protect you? You could assume that without good ventilation, organic vapors will become trapped in the space and build up to levels that may be harmful to you!

Important physical properties to consider include:

- PH (corrosive power)
  The pH scale is a simple way to define acids and bases. This scale assigns a number from 0 to 14 to a solution. Any solution with a pH less than 7 is an acid. Any substance with a pH greater than 7 is a base. A solution with a pH of 7 is neutral.

- Vapor pressure (VP) (chemical’s volatility)
  The vapor pressure is a measure of how much vapor is given off by a chemical at a given temperature. The higher the vapor pressure the more likely it is that you will have signifi-
cant quantities of a chemical in the air above the liquid. Vapor pressure is measured by seeing how “hard” the vapor of a material “pushes” against the sides of a closed container. The more heat that is applied to a liquid, the greater its vapor pressure will become. Vapor pressure is measured in millimeters of mercury (mmHg). Vapor pressure is usually reported for the chemical at room temperature. At higher temperatures the vapor pressure will increase rapidly. If a chemical has a high vapor pressure, more of it will be in the air compared to a chemical with a low vapor pressure.

<table>
<thead>
<tr>
<th>Low Vapor Pressure — less than 1 mmHg @ 68° F</th>
</tr>
</thead>
<tbody>
<tr>
<td>Moderate vapor Pressure — between 1 and 10 mmHg @ 68° F</td>
</tr>
<tr>
<td>High Vapor Pressure — higher than 10 mmHg @ 68° F</td>
</tr>
</tbody>
</table>

- **Ingredients for a fire (Fire Tetrahedron)**
  Flammability is the ability of a solid, liquid or gas to ignite and produce a flame. Four elements are required in specific ratios for combustion to occur: fuel, oxygen, heat, and a chain reaction. This relationship is described by the fire tetrahedron. The fire can be extinguished by taking away any one element of the fire tetrahedron.

- **Flash Point (FLP)**
  The minimum temperature of a liquid at which sufficient vapor is given off to form an ignitable mixture with air near the surface of the liquid. In other words, the temperature where enough fuel will vaporize to have an explosion or fire.

- **Explosive limits**
  The range or limit that the vapors will be mixed sufficiently in air to ignite. Each chemical (that can burn) will have a lower and upper explosive limit (LEL and UEL respectively). If a fuel is within its flammable range and there is sufficient oxygen and an ignition source, you will have an explosion or fire.
• Vapor Density (VD) and Relative Gas Density (RgasD)
  Vapor density tells you if the vapor of a liquid goes up or down in air. Vapor density is measured in comparison with air (air =1). If a chemical has a vapor density greater than one, it means that the vapor will tend to sink to the ground and roll along just like a liquid, collecting in invisible puddles and pools in low lying areas. The material may be nontoxic, but it still may be able to collect in low areas or confined spaces at high enough levels to cause an explosive atmosphere, or to replace oxygen in the air.

These are not all the physical properties of chemicals but they are the ones that most affect workers’ health and safety. Many of these can be identified on a chemical’s MSDS or in the National Institute for Occupational Safety and Health (NIOSH) Pocket Guide.

What is a “hazardous chemical”?

1. A hazardous chemical is any chemical that can do harm to your body.
2. Most industrial chemicals can harm you at some level of exposure and dose.

Health effects of chemicals

Health effects are changes in health resulting from exposure to a chemical. As required under Hazcom training, workers must learn about health effects. Health effects should cover routes of entry into the body, dose response, medically defined health effects (cancer, etc.), latency period, acute and chronic exposures, synergism and legal and recommended exposure limits. These topics will be covered in depth throughout this and following sections. Depending on your type of work and the chemicals you are working with, medical surveillance may also be mentioned.
What is the difference between exposure and dose? Are they the same?

Write down your answer to this question in the space provided below. Take no more than 5 minutes.

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

**The dose makes the poison.**

“All substances are poisons; there is none which is not a poison. The right dose differentiates a poison…” -Paracelsus (1493-1541)

A sixteenth-century Swiss chemist named Paracelsus gave us the most basic rule of toxicology: “The dose makes the poison.” Practically every substance on earth (including water and Vitamin C) can kill you if they are concentrated enough in your stomach or your bloodstream.
The Dose Response Curve

During studies of chemical effects, a dose-response curve is developed for a specific effect within a population. Most dose-response curves take on a characteristic “S” shape, as shown in figure 10.

For instance, let’s take a very common substance—caffeine. If a person consumes 10 grams at one time, that amount would be fatal. However, caffeine is a common substance which is found in our food and beverages.

How do chemicals enter your body?

Chemicals are only a hazard when you have been exposed to them. There are four major routes in which chemicals can enter your body. The most common type of exposure is through inhalation. You inhale the chemical, which would then enter your lungs, where it would be absorbed into your bloodstream. We breathe approximately 20 to 25 thousand breaths in one day, which averages a total volume of 10,000–14,000 liters of air in a day.
The second most common type of workplace chemical exposure is absorption through the skin. For certain chemicals, once it is absorbed through the skin, it goes into the bloodstream.

The third most common type of chemical exposure is through ingestion, where the chemical enters the body through your mouth and is absorbed through the digestive tract. To minimize the ingestion route, good hygiene practices need to be observed—wash your face and hands prior to eating and drinking.

The fourth most common type of chemical exposure is through injection in which the chemical enters the body through a sharp object like a needle, nail or rebar.

**Inhalation is the main route of entry**

The lungs are a critical route of entry for exposure to workplace chemical hazards. If one could take the average set of human lungs and spread them out, they would cover an area the size of a tennis court (140 m$^2$). This means that there is an enormous surface area within the lungs where chemicals can interact with tissue.

The lungs are also important to consider because of the large volume of air (and pollutants in the air) that passes through them continually, as well as the thin membranes in the gas exchange region (alveoli).

- Gases and vapors can reach the deep lungs
- Particle and droplet size affects where the chemical settles in the respiratory tract
- Where the chemical settles in the respiratory tract influences symptoms and diseases
Absorption is the next most common route

The skin has a protective coating of oils which acts as a natural barrier. Fat soluble can pass through the skin and are absorbed into the blood stream. Significant amounts of chemicals are most likely to be absorbed when a large area of skin is in direct contact with a liquid, mist or dust for long periods of time. For some highly toxic substances, dangerous levels may be absorbed from skin contact with gases or vapors. [Hydrogen cyanide is an example of a gas that can be absorbed.] Once in the blood, chemicals are carried throughout the body and can harm other organs. Still other chemicals, such as corrosives, may affect the skin on direct contact. Damaged or very wet skin will allow substances to pass more readily into the blood. A concentrated chemical will pass more easily through the skin’s barrier.

Chemicals also can be absorbed through mucous membranes in the eyes or nose.

- If chemicals get onto the outside of your body they may be able to pass through to your blood stream
- Some areas are more at risk than others such as the eye, reproductive areas, and forehead.
- Open wounds can increase absorption
- Chemical properties affect absorption

Chemicals that are swallowed are absorbed in the digestive tract

Many substances can enter the body through the mouth and digestive tract. This is a less common route of entry than the respiratory system or the skin. A person’s hands may be covered with a toxic dust, say lead, and s/he could then eat, smoke, or apply cosmetics and inadvertently “eat” the dust.

Figure 12. Workers take a lunch break at Ground Zero.
List several ways workers might absorb, inhale, ingest or inject chemicals. Write your answers below. Take no more than 5 minutes.

Chemical exposures are either acute or chronic

Acute exposure is a short term or immediate high dose. Acute exposures can lead to disease or injury which develops immediately or within days. Generally, the effects wear off soon after the exposure ends. Sometimes, however, a permanent illness, such as asthma from chemicals, or cell death from ionizing radiation, can be caused by such an exposure. Eye and throat irritation from Portland cement dust is an example of an acute effect.

- High exposure over a short time (instantaneous to a few days)
- After exposure stops, damage may reverse...or not

Chronic exposure is a repeated, low-to-mid dose of chemical which may lead to disease that develops slowly, over a period of months or years or manifests itself years after exposure. Asbestosis and cancer are examples of chronic illnesses.

- Low exposure over a long time period (years)
- Can cause disease or other irreversible effects

What does latency period mean? What is a classic example?

Write the answer here: **The time period from dose to onset of disease symptoms, e.g. asbestosis can take up to 25 years after a dose to the lungs.**
Permanent vs. Reversible

Some tissues and systems can reverse damage if the effect was not too bad.
List an example: ________________________________

Some tissues cannot mend.
List an example: ________________________________

What is the difference between local and systemic harm?

Some chemicals harm the body at the site of their exposure, such as an acid burn. Other chemicals can affect entire body systems, such as lead and alcohol. Some can do both, such as alcohol.

Section 5: Review of Common Health Effects

Now that we have covered some basic physical and toxicological properties of chemicals, let’s look at some of the health outcomes that may develop from chemical exposure.

Simple and chemical asphyxiants

Some chemicals interfere with the body’s ability to use oxygen. They may do this in different ways. For example, a chemical may prevent the transfer of oxygen by the blood (carbon monoxide), inhibit cellular respiration (hydrogen sulfide), or simply displace the oxygen in the air you are breathing (carbon dioxide).
Case Study

On November 5th, 2005, two contract employees were overcome and fatally injured by a nitrogen-rich atmosphere as they performed maintenance work near a 24-inch opening on the top of a reactor. One of the workers died attempting rescue. Confined space entry requires specialized training and equipment!

What do sensitizers and allergens do?

Sensitizers and allergens cause a reaction in an individual. The reaction depends upon the affected individual. Once someone is sensitized or allergic to a chemical, much lower exposures can cause a reaction, and the reaction can become more severe.
List several substances that can cause an allergic reaction in the space below. Take no more than 5 minutes.

Corrosives are widely used in chemical manufacturing as well as construction. Understand which products you are working with (such as etching concrete with hydrofluoric acid) before you begin work.

- Acids and bases are corrosive chemicals
- Corrosives can damage skin, eyes and the respiratory system
- The extent of skin damage depends on how long the corrosive is on the skin and the toxicity level (concentration) of the corrosive.
- Corrosives are especially damaging to the eyes and lungs

**Mutagens cause genetic changes that can lead to birth defects**

Mutagens cause genetic mutations or change. These mutations can cause birth defects or other problems in following generations or may lead to cancer in the exposed person.

**What are teratogens?**

Teratogens are compounds that can harm the developing fetus, causing birth defects or death.

The worst case of a teratogen exposure to a population en mass is the Minamata Bay, Japan incident which was discovered in 1956. In this case, methyl mercury was used as a catalyst in a
chemical process at Chisso Corps’ chemical factory, which continued to dump the product from 1932 to 1968 into Minamata Bay.

How must carcinogens be handled?

Carcinogens are cancer-causing compounds. Some chemicals are known human carcinogens, others are only suspected to be carcinogens. Manufacturers are required to list any carcinogens in their products, even if the amount is as low as 0.1% of the product. NIOSH states there is no known safe exposure level for carcinogens so employers and workers should try for NO exposure!

Here are a few known and suspected carcinogens:

• Asbestos
• Benzene
• Beryllium
• Cadmium
• Cigarette smoke
• Vinyl Chloride

A Chemical’s effect on the body depends on many factors

Chemical exposure and toxicological outcomes are still sciences in their infancy. There are many factors that can play a role in how a chemical or a combination of chemicals harm workers. Therefore it is best to reduce all chemical exposures to as low as possible. Below is a short list of factors that affect a chemical’s effect on the body:

• The physical form of the chemical
• Route of entry
• The dose
• Chemical toxicity
• Individual (age, sex, race, weight, etc.)
• Chemicals can produce different health effects and sometimes can produce more than one
Section 6: Measurement and Exposure Limits

We will now briefly review measurement of chemicals, units of measure and exposure limits.

Measuring chemicals

Air monitoring is required to be reviewed under Hazcom training. If you are at a job site and are receiving Hazcom training, you should be made aware, in some type of training, that the work site has the capability to monitor for the chemical exposures you may face. If you have any questions concerning air monitoring, please see a supervisor, Union steward or site health and safety professional.

Chemical exposures may be measured with equipment, such as:

- Photo Ionization Detector (PID)
- Colorimetric tubes
- Combustible Gas Indicator (CGI)
- Oxygen meter
- Multi-gas meter
- Personal monitoring

Units used for measuring chemicals

Understanding these units will help you recognize monitoring results and allow you to apply exposure limits.

Common units of measure include:

- Parts Per Million (ppm)
- Milligrams per cubic meter (mg/m³)
- Percent (%)
- Fibers per cubic centimeter (f/cc)
Match the substances listed in the table with their appropriate units of measure from the list above. Take no more than 5 minutes.

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>Units</th>
</tr>
</thead>
<tbody>
<tr>
<td>Asbestos</td>
<td></td>
</tr>
<tr>
<td>Oxygen</td>
<td></td>
</tr>
<tr>
<td>Organic solvents</td>
<td></td>
</tr>
<tr>
<td>Dust</td>
<td></td>
</tr>
</tbody>
</table>

**What are the main exposure limits?**

Exposure limits are a way to compare a worker's exposure on the job with an assumed “safe” limit, which was derived from scientific study. It can be argued that many exposure limits are too low and most chemicals do not have an exposure limit. However, they are all we have to assist us in protecting workers. Some exposure limits are guidelines (usually more protective) and some are the Law (though usually not as protective as guidelines). Below are the three main exposure limits used to protect workers.

- OSHA Permissible Exposure Limits (PELs). PELs are the Law!
- ACGIH Threshold Limit Values (TLVs)
- NIOSH Recommended Exposure Limits (RELs)

**More on exposure limits**

Exposure limits are based on 8-hour time-weighted average (TWA) for OSHA or ACGIH or 10-hour TWA averages for NIOSH, ceilings (cannot exceed), or 15-minute peak exposures. Exposures must be kept below OSHA PELs. Most exposure limits are for airborne exposures. Exposure limits do not take into account exposure from multiple chemicals.
Section 7: Hazard Communication Systems

How do you get information about hazardous chemicals? We will now look at the most common and mandated methods for communicating chemical hazards to workers. One of the best methods for communicating hazards is by training, which we covered in Section 3. Below are two additional methods that can effectively communicate hazards posed by chemicals.

1. Material Safety Data Sheets (MSDSs)
2. Labels and placards

1. MSDS

The MSDS is a detailed information bulletin prepared by the manufacturer or importer of a chemical that describes the physical and chemical properties, physical and health hazards, routes of exposure, precautions for safe handling and use, emergency and first aid procedures, and control measures. Chemical manufacturers and importers must develop an MSDS for each hazardous chemical they produce or import, and must provide the MSDS automatically at the time of the initial shipment of a hazardous chemical to a downstream distributor or user. Distributors also must ensure that downstream employers are similarly provided an MSDS.

Each MSDS must be in English and include information regarding the specific chemical identity of the hazardous chemical(s) involved and the common names. In addition, information must be provided on the physical and chemical characteristics of the hazardous chemical; known acute and chronic health effects and related health information; exposure limits; whether the chemical is considered to be a carcinogen by NTP, IARC, or OSHA; precautionary measures; emergency and first aid procedures; and the identification (name, address, and telephone number) of the organization responsible for preparing the sheet.
There are several key pieces of information that must be on an MSDS but there is no required format. The next several paragraphs cover required information that must be on an MSDS.

**Product identity and manufacturer’s information**
The product identity must appear on the MSDS exactly as it appears on the product label. Small differences in chemical names can have deadly consequences. The MSDS must include how to contact the manufacturer. This includes the manufacturer’s name, address, emergency and non-emergency phone numbers, the date the MSDS was prepared, and an optional signature.

**Hazardous ingredients**
Chemical name and common names of the hazardous chemicals in the product, exposure limits (permissible exposure limits (PELs) and threshold limit values TLVs), and a percent by weight of the hazardous ingredients.

**Physical and chemical characteristics**
- Appearance/odor–A brief description of the material
- Boiling point–The temperature at which a liquid turns into a vapor
- Evaporative rate–The rate at which a liquid converts to a gas
- Melting point–The temperature at which a solid turns into a liquid
- Solubility (Sol) –The amount of a solid or liquid that will dissolve in another liquid
- Specific gravity (SG) –The weight of a chemical compared to the weight of water
- Vapor density (VD) –The weight of a chemical's vapor compared to air
- Vapor pressure (VP) –The force exerted by a liquid as it changes into a gas

**Fire and explosion hazard data**
- Flash point (F.I.P.) –The minimum temperature at which a liquid produces enough vapor to ignite if an ignition source is introduced
- Flammable or combustible–A product is flammable if its flashpoint is less than 100 degrees Fahrenheit and combustible if its flashpoint is greater than 100° F
- Flammable limits–Range of gas or vapor concentrations that will burn or explode if an ignition source is present. When a substance is in the air in a concentration above its lower
explosive limit (LEL) and below the upper explosive limit (UEL), danger of sudden explosion or flashover is present. Instruments such as photo ionization detectors will read LEL levels. Generally, any level above 25 percent of the LEL in open air is considered hazardous. That safe level drops to 10 percent of the LEL in a confined space.

- Extinguishing media—Typical extinguishing media are water, fog, foam, alcohol foam, CO2, and dry chemicals
- Special fire fighting procedures—Equipment and procedures needed for fighting a fire involving the chemical
- Unusual fire/explosion hazards—This section identifies the gases or other materials that are given off by a chemical that may cause a fire or an explosion
- Autoignition point—The lowest temperature at which a flammable gas-air or vapor-air mixture ignites from its own heat source or from contacting a heated surface without the necessity of a spark or flame

Health hazard data
- Signs and symptoms of exposure
- Any medical conditions that are generally recognized as being aggravated by exposure to the chemical
- Route(s) of entry: Inhalation? Skin? Ingestion?
- Acute and chronic health hazards
- Cancer agents
- Emergency and first aid procedures

Reactivity data
A chemical labeled “reactive” has a tendency to undergo a chemical change and release energy. If the chemical can undergo changes that cause pressure, heat, or hazardous decay under normal conditions of use, then the manufacturer must mark it on the MSDS as UNSTABLE. Even when a chemical is considered to be stable, this section may contain special instructions such as:
• Incompatibility with other chemicals
• Hazardous decomposition or byproducts
• Hazardous polymerization, which is a chemical reaction in which two or more small molecules combine to form larger molecules

**Spill and disposal Procedures**
The spill and disposal procedures section will generally outline incidental spill response criteria such as what equipment or spill cleanup media to use in the event of a spill. Even before you reach for MSDS spill response procedures, you must be familiar with your employers spill response program and follow procedures outlined there first.

**Protection information**
• Acute and chronic health hazards
• Routes of entry
• Carcinogenicity
• Signs and symptoms of exposure
• Medical conditions aggravated by exposure
• Emergency or first aid procedures

**Handling and storage**
• Recommendations for cleanup and decontamination
• Spill containment procedures
• Waste disposal methods
• Storage precautions

**Miscellaneous information**
Where are MSDSs located at your site?

Copies of the MSDS for hazardous chemicals in a given worksite are to be readily accessible to employees in that area. As a source of detailed information on hazards, they must be readily available to workers during each work shift.

• You must be informed where the MSDS sheets are at your work site
• You must be allowed access to them
• You must be allowed to review them on work time
• You must be allowed to ask questions pertaining to MSDSs and chemicals that you use

OK, now let's do a short, small group activity to practice reviewing an MSDS.

Activity 3: Reviewing an MSDS

Time for activity: 15 minutes (10 for group work and 5 for report back)

Objective: The goal of this activity is to practice reviewing an MSDS. An MSDS is one of the main tools in hazard communication. This activity will allow you to review an MSDS on a chemical you work with and answer (and ask) questions that pertain to it.

Task: Take a few minutes to review and become familiar with the MSDS sheet that your instructor assigns you in Appendix B or a site-specific MSDS that your instructor provides. In your groups, work together to discuss and to answer the following questions regarding the provided MSDS. Try to justify all answers. Select a spokesperson to report back your group’s answers to the class. Try to come to a mutual answer for each of the questions.

1. What is the name of the product?
2. List the CAS #.

3. What’s the date the MSDS was generated or updated?

4. What are the health hazards of this product?

5. Is there a fire or explosion hazard with this product?
6. Is this material incompatible with other chemicals or materials?

7. Are there conditions that may cause this material to become unstable?

8. Will this chemical sink or float in water and why?

9. Will this chemical dissolve in water and why?
10. Will it evaporate quickly or slowly? How can you tell?

11. Is this chemical corrosive? What is its pH?

12. List any potential health effects for this chemical.

13. If you are exposed to this chemical, what should you do?
2. Types of labeling systems

There are different types of labeling systems that should be in place to help you recognize when hazardous chemicals are present in the work area. These labeling systems are:

- HMIS
- NFPA 704 M
- DOT placards
- Product labels

Hazardous Materials Identification System (HMIS)

The Hazardous Materials Identification System (HMIS) was created by the American Coding Association. It uses rectangular labels which may be found on bulk storage units or smaller containers at a site. The HMIS system addresses four topics. For health, flammability and reactivity, a number from 0 to 4 is assigned based on the severity of the hazards, just like NFPA. The higher the number, the more severe
the hazard. The fourth designation is for Personal Protective Equipment. These PPE recommendations apply to normal use and may not be adequate for an emergency. Although chronic health effects usually are not rated, they may be indicated after the health hazard rating or by written warnings in the upper white section of the label.

HMIS labels also contain the name of the product and more specific hazard information including:

- Routes of entry
- Health hazards
- Target organs and effects
- Physical hazards.

**NFPA 704 M diamond**

Originally developed to quickly warn fire fighters about potential chemical hazards in a fire, the National Fire Protection Association (NFPA) labeling system provides important information to the construction worker. However, use of the NFPA labels is not required by OSHA. The NFPA label is a diamond containing four smaller diamonds of different colors. The colors of the smaller diamonds are red (flammability), blue (health hazard), yellow (reactivity hazard), and white (specific hazards). The red, blue, and yellow squares contain a hazard rating from 0 to 4, which indicates the severity of the hazard, with 4 being the most dangerous. The white square is reserved for symbols that represent specific hazards, such as to not mix with water or radiation.

![NFPA 704 M diamond diagram](image)

Figure 19. Examples of specific hazards that may appear in the white portion of a NFPA diamond.
DOT placards are for shipping, not fixed structures

The Department of Transportation (DOT) requires trucks and trailers, railroad cars, and many marine vessels to display placards indicating the hazards presented by material in shipment. Labels, which are smaller, are usually found on packages, carboys, and other smaller containers being transported or stored. These placards and labels are in addition to what OSHA requires.

HAZMAT placards

Placards are diamond-shaped, 10 ¾-inches square, point-on-point fixtures. They should be located on all four sides of a vehicle carrying a quantity of hazardous materials that requires placarding.

Placards provide recognition information in a number of ways:

• Background color
• Symbol at the top
• Hazard class wording or identification number in the center
• United Nations (UN) hazard class number at the bottom

These graphics summarize the color-coded backgrounds, hazard words, and symbols found on DOT placards.
Product labels

Under OSHA regulations, all manufacturers, importers, and distributors of hazardous chemicals must label products with information that informs you of the hazards of the product. Information might be presented on the container in the form of a sign, symbol, or with written words. The employer may not remove these labels. If the product is transferred to another container, that container must be labeled too. The only circumstances where containers without labels may be used is when using portable containers either to transfer chemicals from one labeled container to another or when the product is intended for immediate use by the person performing the transfer. Immediate use is when the hazardous chemical will be under the control of and used only by the person who transfers it from a labeled container and only within the work shift in which it is transferred.

What is on the product label?

A label of course may have lots of other information not related to its hazards—amounts, advertising, directions for use, etc. But the label must include a list of the hazardous ingredients, a hazard warning and the name and address of the manufacturer. Sometimes this information is on the back or side of the container.
Case study

Fiber-cement materials—a green construction material and potentially hazardous to workers:

- Hardiplank [10-50%] crystalline silica
- Weatherboard [45-55%] crystalline silica

WISHA inspection data: 5 of 7 workers using circular saws outdoors on fiber-cement siding were exposed above ACGIH-TLV for silica.

Section 8: Controls

The hierarchy of controls can protect you from hazardous chemicals.

The hierarchy of controls is a list of methods, in order from most desirable to least desirable, which emphasizes controlling a hazard at its source. This is done by giving preference to eliminating the hazard altogether; then to the use of the engineering controls. These types of strategies should be used first, where possible, because they are less subject to human error and because they are less disruptive and uncomfortable for people to use and for people working in the area. Whichever methods you use, remember that in each case their effectiveness should be monitored regularly.

The overall idea is to design or redesign the workplace to fit the needs of workers. Training workers and providing Personal Protective Equipment is necessary but, creating as safe and healthy a workplace as possible is the ultimate goal. Achieving the goal requires methods such as substituting less dangerous chemicals or processes in place of harmful ones, designing workstations to cause less harm to workers, and by integrating health and safety of the workplace into the design stages of workplaces and work process development.
Eliminate or substitute chemicals you currently use with less harmful ones

Are there any chemicals you could eliminate or substitute at your job? Is it possible to make that substitution? Green chemistry and green jobs may be a good avenue for substitution or elimination. However, just because it is “green”, does not always mean it is safe!

Use engineering controls to reduce chemical exposures

Use ventilation, enclosures and High Efficiency Particulate Air (HEPA) vacuums to control chemical exposures before they reach workers.

![Figure 25. Local exhaust ventilation captures welding fumes before they reach the worker.](image)

![Figure 26. Vacuum captures concrete dust as it exits the saw.](image)

Administrative controls can also reduce chemical exposures

Administrative controls are any procedure that significantly limits daily exposure by control or manipulation of the work schedule or manner in which work is performed. Administrative controls are not as effective as engineering controls but many are quick and inexpensive to implement.

- Training and information
- Signage
• Maintain equipment to prevent leaks and releases
• Standard Operating Procedures (SOPs)
• Worker rotation
• Scheduling tasks when chemical use is low

When working with chemicals, it is a good idea to know how to take first aid measures if exposed. This would also require workers to receive proper first aid training and for the employer to have equipment available that is easily accessible.

**Use Personal Protective Equipment (PPE) as a last option to prevent chemical exposures**


**There are four levels of PPE**

• Level A
• Level B
• Level C
• Level D

The Environmental Protection Agency defined PPE levels A through D. Levels A through C are different chemical protective clothing ensembles with respirators. They are used by trained workers when a higher level of protection is required for actions like emergency response, paint booth work or asbestos abatement. Level D, with the addition of eye protection, gloves, aprons, etc. is what most workers would use to protect against basic chemical hazards. Again, when Levels A through C are used, they require additional training, medical clearance and the knowledge that the chemical hazards is probably severe.

After exhausting the controls process, you may be left with using PPE as your only protection. On most MSDSs, a list of recommended PPE will be given but, it may only state something close to the following: “For handling of chemical, use appropriate gloves and respirator.” Now what does “appropriate” mean? They may not spell out or list which type of PPE you will need. You may have to find that information in some of the other recourses we mentioned or hopefully, your industrial hygienist, or other competent person, has already chosen the correct PPE for you to use.
Section 9: Spill Response

The differences between an emergency and an “incidental spill” are level of hazard, risk, familiarity and training. REMEMBER, you are not trained for emergency response. Inform your supervisor of unusual odors, spills, or releases, etc. Inform coworkers and leave an area of a large spill or chemical release. Follow your employer’s spill response program for further information. If it is an incidental spill in your work area, depending on your employer’s spill response program, you may be allowed to clean it up. Only clean up spills that are of known origin, small and incidental in nature, in your work area, you have the right spill cleanup equipment, and you feel comfortable doing so. Anything else should be left to trained spill responders.

Let’s conduct a short activity on spill response.

Activity 4: Reviewing components of your Spill Response Plan(s)

Time for activity: 15 minutes (10 for group work and 5 for report back)

Objective: The goal of this activity is to review some components of your work site’s Spill Response Plan so that you may become familiar or refreshed with some of the aspects including, differences between “small” and “large” spills, emergency notification procedures and types of chemicals stored at your work site and used by you and your coworkers.

Task: In your groups, work together to discuss and answer the following questions regarding your work site’s Spill Response Plan components. Your instructor will provide a site-specific plan or use the one provided in Appendix C. Try to justify all answers. Select a spokesperson to report your group’s answers to the class. Try to come to a mutual answer for each of the questions.

1. Take a few minutes to review and become familiar with the pages you received from the Spill Response Plan.
2. How can you tell if a spill is small or large?

3. Does your work site maintain a supply of spill response equipment? If yes, list some of the items. If no, list some items that should be kept on site for spill response.

4. What is the emergency notification procedure?

What if you have been exposed to a chemical?

1. Let your supervisor know.
2. Find out which chemical(s) were involved.
3. Follow the first aid directions in the MSDS.
4. Get medical attention as needed.
Section 10: GHS and REACH

Globally Harmonized System of Classification and Labeling of Chemicals (GHS): The GHS, first adopted by the Sub-Committee on the Globally Harmonized System of Classification and Labeling of Chemicals (SCEGHS) in December 2002, is an initiative to establish international consensus on criteria for classifying chemical hazards for international distribution, and to create consistent requirements for MSDSs. The GHS has been revised twice: once in 2005, and again in 2007. According to the GHS Sub-Committee of Experts, the GHS is now ready for worldwide implementation.

GHS is a common and coherent approach to defining and classifying hazards, and communicating information on labels and safety data sheets. Target audiences include workers, consumers, transport workers, and emergency responders. GHS provides the underlying infrastructure for establishment of national, comprehensive chemical safety programs.

Globally, Hazcom systems are different and use multiple labels and safety data sheets for the same product in international trade

No country has the ability to identify and specifically regulate every hazardous chemical product. For example, in the United States, there are an estimated 650,000 such products. Adoption of requirements for information to accompany the product helps address protection needs. Many different countries have come to the same conclusion about using information dissemination as a regulatory means to address chemical hazards. While similar, they are different enough to require multiple labels and safety data sheets for the same product in international trade. Countries with regulation systems have different requirements for hazard definitions, as well as different information to be included on a label or material safety data sheet. For example, a product may be considered flammable or toxic in one country, but not in another to which it is being shipped. These differences impact both protection and trade. In the area of protection, users in countries that don’t have specific requirements may see different label warnings or data sheet information for the same chemical. In the area of trade, the need to comply with multiple regulations regarding hazard classification and labeling is costly and time-consuming. Small-to-medium enterprises are effectively precluded from international trade in chemicals due to the regulatory burden of compliance.
GHS was created to try to standardize Hazcom Globally.

Benefits of using GHS include:

- Enhanced protection for workers
- Facilitates international trade in chemicals
- Reduce testing and evaluation
- Facilitates globally sound management of chemicals

U.S. agencies with requirements for labels and MSDSs are actively involved in the GHS development process, which may be adopted by legislation in congress or by regulation in each affected agency.

GHS increases worker protection over OSHA Hazcom by covering all hazardous chemical substances, dilute solutions and mixtures, pharmaceuticals, food additives, cosmetics and pesticide residues in food, as well as chemicals in transport.

A new hazard classification system under GHS

GHS uses classification criteria for hazards and a hazard communication system to protect workers.

Figure 27. Example of GHS new hazard communication system.
Transportation placarding stays roughly the same

For transportation, pictograms will have the background and symbol colors currently used, as shown in Figure 28.

![GHS transportation placards](image)

Figure 28. GHS transportation placards.

Hazard communication for basic worker use

Other sectors’ pictograms will have a black symbol on a white background with a red diamond frame. Single words ("Danger" and "Warning") are used to emphasize hazard and discriminate between levels of hazard. A GHS label should also include appropriate precautionary information.

![GHS chemical hazards pictograms](image)

Figure 29. GHS chemical hazards pictograms (non transportation).
GHS will also have a single harmonized hazard statement for each level of hazard within each hazard class. As an example take flammable liquids:

Category 1: Extremely flammable liquid and vapour
Category 2: Highly flammable liquid and vapour
Category 3: Flammable liquid and vapour
Category 4: Combustible liquid

GHS Safety Data Sheets (SDSs) will provide comprehensive chemical information for workers far beyond what has been required under OSHA.

- Identification
- Hazard(s) identification
- Composition/information on ingredients
- First aid measures
- Fire fighting measures
- Accidental release measures
- Handling and storage
- Exposure control/personal protection
- Physical and chemical properties
- Stability and reactivity
- Toxicological information
- Ecological information
- Disposal considerations
- Transport information
- Regulatory information
- Other information

Registration Evaluation and Authorisation of Chemicals (REACH)

REACH is a European Union (EU) standard that was put into effect in 2007. It is basically an advanced form of chemical inventory and registration which heavily focuses on chemical safety and sharing of information. Its main goal is to achieve a high level of protection for human health and the environment. REACH shifts the burden of proving chemicals are safe to manufacturers of chemicals. Manufacturers are required to register their substances and provide environmental, health and safety data if they want them to stay/be on the market. This is great for workers since workers have been historically used as the test subjects—only after a harmful health effect is recognized, are protections implemented. This new regulation turns the use of workers as test subjects on its head. Below are the main components of REACH:

- Manufacturers and importers of chemicals > 1 ton/yr are required to register their substances to demonstrate they can be used safely
- Evaluation of some substances by Member States/European Chemicals Agency (ECHA)
- Authorization only for substances of very high concern
• Restrictions when risks are unacceptable
• Science based
• Information and cost sharing
• Information flows both up and down the supply chain
• Communication up and down supply chains
• 12-yr information availability access
• Includes labelling requirements
• Sanctions if manufactures do not comply
• Public/community safety net if harmful chemicals slip past the REACH process

The goal in the EU is to register 30,000 chemicals! REACH should help to reduce the risks workers face from chemicals due to stricter chemical regulation and a more open sharing of chemical hazard information.

So we come to the end of Hazcom

You have rights under OSHA that allow you to be informed of all chemicals you use in your work area, before you use them. If new information should come into existence about chemicals you use, you have a right to be told about that new information in a timely manner, not to exceed 30 days. You have the right to know where your employers’ written Hazcom program is, as well as to understand where to find MSDSs and have access to them. These are just a few rights that the Hazcom Standard gives workers so that they can work around chemicals with a

Figure 30. Carpet layer use a knee kicker to install carpet. Courtesy eLOSHimages.com, Earl Dotter.
decreased chance of suffering harm. Your work should not harm or kill you! If you have any further questions, please discuss them with your supervisor, Union steward or you may contact CPWR at 301-578-8500, cpwrwebsite@cpwr.com.

Resources


Appendix A: Glossary

ACGIH: American Conference of Governmental Industrial Hygienists. ACGIH develops and publishes recommended occupational exposure limits for chemical substances and physical agents.

Acid: Any chemical that undergoes dissociation in water with the formation of hydrogen ions. Acids have a sour taste and may cause severe burns. They turn litmus paper red and have pH values of 0 to 6.

Acute effect: Adverse effect on a human or animal body that takes place soon after exposure.

Acute toxicity: Adverse effects resulting from a single dose of or exposure to a substance.

Air-line respirator: A respirator that is connected to a compressed breathable air source by a small-diameter hose. The air is delivered continuously or intermittently in a sufficient volume to meet the wearer’s breathing requirements.

APR: Air-Purifying Respirator. A respirator that uses chemicals to remove specific gases and vapors from the air or that uses a mechanical filter to remove particulate matter. An air-purifying respirator must be used only when there is sufficient oxygen to sustain life and the air contaminant level is below the concentration limits of the device.

Alkali: Any chemical substance that forms soluble soaps with fatty acids. Alkalis are also known as bases and may cause severe burns. Alkalis turn litmus paper blue and have pH values from 8 to 14.

Asbestosis: Chronic lung disease caused by inhaling airborne asbestos fibers.

Asphyxiant: Vapor or gas that causes unconsciousness or death by suffocation. Most simple asphyxiants are harmful to the body only when they become so concentrated that they reduce oxygen in air (normally 20.9 %) to dangerous levels (16 percent or lower). Some chemicals, such as carbon dioxide, function as chemical asphyxiants by reducing the blood’s ability to carry oxygen.

Base: Substances that usually liberate OH anions when dissolved in water. Bases react
with acids to form salts and water. Bases have a pH greater than 7, turn litmus paper blue, and may be corrosive to human tissue. A strong base is called alkaline or caustic.

**Carbon dioxide (CO\(_2\))**: Heavy, colorless gas produced by combustion and decomposition of organic substances and as a by-product of chemical processes. Will not burn, relatively nontoxic, and unreactive. Can cause oxygen-deficient environments in large concentrations. Is useful as fire-extinguishing agent to block oxygen and smother fire.

**Carbon monoxide (CO)**: Colorless, odorless, flammable, and very toxic gas produced by the incomplete combustion of carbon compounds and as a byproduct of many chemical processes. A chemical asphyxiant, it reduces the blood’s ability to carry oxygen.

**Carcinogen**: Substance or agent capable of causing or producing cancer in mammals.

**CAS**: An assigned number that identifies a chemical. CAS stands for Chemical Abstracts Service, an organization that indexes information published in Chemical Abstracts by the American Chemical Society and that provides index guides by which information about particular substances may be located in the abstracts. The CAS number is a concise, unique means of material identification.

**Ceiling (C)**: Maximum allowable human exposure limit for airborne substances; not to be exceeded even momentarily.


**Chemical**: Any element, chemical compound, or mixture of elements and/or compounds.

**Chemical manufacturer**: An employer in a workplace in which chemicals are produced for use or distribution.

**Chemical name**: Scientific name that clearly identifies the chemical for hazard evaluation purposes.

**Chemical reactivity**: Ability of a material to chemically change. Undesirable and dangerous effects, such as heat, explosions, or the production of noxious substances, can result.

**Chronic effect**: Adverse effect on a human or animal body with symptoms that develop slowly over a long period of time or that recur frequently.

**Chronic exposure**: Long-term contact with a substance.
Combustible liquids: Term used by NFPA and DOT to classify certain liquids that will burn, on the basis of flash points. NFPA and DOT generally define “combustible liquids” as having a flash point of 100° F or higher. They do not ignite as easily as flammable liquids; however, they can be ignited under certain conditions, and must be handled with caution.

Container: Any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank, or the like that contains a hazardous chemical. Under hazard communication rules (1910.1200), pipes or piping systems, and engines, fuel tanks, or other operating systems in a vehicle are not considered to be containers.

Corrosive: Liquid or solid that causes visible destruction or irreversible alterations in skin tissue at site of contact, or liquid that has severe corrosion rate on steel.

DOT: U.S. Department of Transportation

Dust: Solid particles suspended in air produced by some mechanical process, such as crushing, grinding, abrading, or blasting. Most dusts are inhalation, fire, or dust explosion hazards.

Employee (worker): A worker who may be exposed to hazardous chemicals under normal operating conditions or in foreseeable emergencies.

Employer: A person engaged in a business in which chemicals are either used, distributed, or produced for use or distribution, including a contractor or subcontractor.

Engineering controls: Systems that reduce potential hazards by isolating the worker from the hazard or by removing the hazard from the work environment. Methods include ventilation, isolation, and enclosure.

EPA: Environmental Protection Agency

Explosive: Material that produces a sudden, almost instantaneous release of pressure, gas, and heat when subjected to abrupt shock, pressure, or high temperature.

Exposure: An employee who is subjected during the course of employment to a chemical that is a physical or health hazard; includes accidental or possible exposure. “Subjected” includes any route of entry: inhalation, ingestion, skin contact, or absorption.

Exposure limits: Concentration in air of a chemical that is thought to be acceptable.
**Flammable limits**: Minimum and maximum concentrations of flammable gas or vapor between which ignition occurs.

**Flash Point (Fl.P.)**: Temperature at which a liquid will give off enough flammable vapor to ignite. There are several methods for testing flash points; flash points for the same material may vary depending on the test method.

**Fume**: Airborne suspension consisting of minute solid particles arising from the heating of a solid.

**Gas**: Formless fluid that occupies the space of its enclosure. Can settle to the bottom or top of an enclosure when mixed with other materials. Can be changed to its liquid or solid state only by increased pressure and decreased temperature.

**Hazardous chemical**: Any chemical whose presence or use is a physical hazard or a health hazard.

**Hazardous material**: Any substance or mixture of substances having properties capable of producing adverse effects on the health or safety of a human being.

**Hazardous Materials Identification System (HMIS)**: Developed by the NPCA to provide information about health, flammability, and reactivity hazards encountered in the workplace. A number is assigned to a material indicating the degree of hazard, from 0 for the least up to 4 for the most severe. Letters are used to designate personal protective equipment.

**Health hazard**: A chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees.

**Ingestion**: Taking in a substance through the mouth.

**Inhalation**: Breathing in a substance as a gas, vapor, fume, mist, or dust.

**Irritant**: Substance that will cause an inflammatory response or reaction of the eye, skin, or respiratory system.

**Label**: Any written, printed, or graphic sign or symbol displayed on containers of hazardous chemicals; includes identity of the material, appropriate hazard warnings, and name and address of the chemical manufacturer, importer, or other responsible party.

**Latency period**: Time that elapses between exposure and the first manifestations of disease or illness.
Local effects: Toxic or irritation effects that occur at the site of contact with a chemical or substance.

Local ventilation: Drawing off and replacement of contaminated air directly from its source.

Lower Explosive Limit (LEL): Lowest concentration (percentage of the substance in air) that will produce a flash of fire when heat, electric arc, or flame is present.

Material Safety Data Sheet (MSDS): Written or printed material concerning a hazardous chemical prepared in accordance with 1910.1200(g).

Mist: Suspended liquid droplets in the air generated by condensation from the gaseous to the liquid state or by mechanically breaking up the liquid by splashing or atomizing.

mm Hg: A measure of pressure in millimeters of a mercury column above a reservoir, or difference of level in a U-tube.

NFPA: National Fire Protection Association

NIOSH: National Institute for Occupational Safety and Health

Oxidizer: Substance that yields oxygen readily to stimulate the combustion of organic matter.

Parts per million (ppm): Unit for measuring concentration of a gas or vapor in air. Parts of the gas or vapor in a million parts of air. Also used to indicate the concentration of a particular substance in a liquid or solid.

(PEL): The PEL indicates the permissible concentration of air contaminants to which nearly all workers may be repeatedly exposed 8 hours a day, 40 hours a week, over a working lifetime (40 years), without adverse effects.

Personal Protective Equipment (PPE): Devices or clothing worn to help isolate a worker from direct exposure to hazardous materials.

pH: Scale of 0 to 14 representing acidity or alkalinity of aqueous solution. Pure water has pH of 7.

Physical hazard: A chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water reactive.
**Recommended exposure limit (REL):** A exposure limit from NIOSH. The highest allowable airborne concentration that is not expected to injure a worker. Expressed as a ceiling limit or as a time-weighted average, usually for a 10-hour work shift.

**Reproductive hazard:** Any agent that has a harmful effect on the adult male or female reproductive system or the developing fetus or child.

**Respiratory system:** Breathing system, including the lungs and air passages, as well as the associated system of nerves and circulatory supply.

**Respiratory protection:** Devices that will protect the wearer's respiratory system from overexposure by inhalation of airborne contaminants. Respiratory protection is used when a worker must work in an area where he/she might be exposed to concentration in excess of the allowable exposure limit.

**Routes of entry:** Means by which material may gain access to the body (inhalation, absorption, ingestion, or penetration).

**SCBA:** Self-contained breathing apparatus

**Sensitization:** State of immune-response reaction in which further exposure elicits an immune or allergic response. A person previously exposed to a certain material is more sensitive when he experiences further contact with it.

**Sensitizer:** Substance that, on first exposure, causes little or no reaction in humans or test animals but that, on repeated exposure, may cause a marked response not necessarily limited to the contact site.

**Solvent:** Substance, usually liquid, in which other substances are dissolved. Water is the most common solvent.

**STEL:** Short-term exposure limit.

**Teratogen:** Substance or agent to which exposure of a pregnant female can result in malformation of the fetus.
**Threshold Limit Value (TLV):** Established by ACGIH. Airborne concentration of a material to which nearly all persons can be exposed day after day, without adverse effects. TLVs are expressed in three ways:

1. TLV-C Ceiling limit: concentration that should not be exceeded even instantaneously.
2. TLV-STEL Short-term exposure limit: maximum concentration for a continuous 15-minute exposure period.
3. TLV-TWA Time-weighted average: concentration for a normal 8-hour work day or 40-hour work week.

**Toxicity:** Sum of adverse effects resulting from exposure to a material, generally by the mouth, skin, or respiratory tract.

**Toxicology:** Study of the nature, effects, and detection of poisons in living organisms. Also, substances that are usually harmless but toxic under certain conditions.

**Upper Explosive Limit (UEL):** Highest concentration (percentage of the substance in air) that will produce a flash of fire when heat, electric arc, or flame is present.

**Vapor:** Gaseous state of a material suspended in air that would be a liquid or solid under ordinary conditions.

**Vapor density:** Weight of vapor or gas compared to an equal volume of air; expression of the density of the vapor or gas.

**Vapor pressure:** Pressure exerted by a saturated vapor above its liquid in a closed container.

**Work area:** A room or defined space in a workplace where hazardous chemicals are produced or used and where employees are present.

**Workplace:** An establishment at one geographical location containing one or more work areas.
Appendix B: Material Safety Data Sheets

The following pages of this appendix contain examples of material safety data sheets (MSDS’s) concerning the following chemicals:

- Toluene - pages B-2 through B-7
- Hydrofluoric Acid, Aqueous 49% - pages B-8 through B-15
Material Safety Data Sheet
Toluene MSDS

Section 1: Chemical Product and Company Identification

<table>
<thead>
<tr>
<th>Product Name:</th>
<th>Toluene</th>
</tr>
</thead>
<tbody>
<tr>
<td>Catalog Codes:</td>
<td>SLT2857, SLT3277</td>
</tr>
<tr>
<td>CAS#:</td>
<td>108-88-3</td>
</tr>
<tr>
<td>RTECS:</td>
<td>XS5250000</td>
</tr>
<tr>
<td>TSCA:</td>
<td>TSCA 8(b) inventory: Toluene</td>
</tr>
<tr>
<td>CI#:</td>
<td>Not available</td>
</tr>
<tr>
<td>Synonym:</td>
<td>Toluol, Tolu-Sol; Methylbenzene; Methacide; Phenylmethane; Methylbenzol</td>
</tr>
<tr>
<td>Chemical Name:</td>
<td>Toluene</td>
</tr>
<tr>
<td>Chemical Formula:</td>
<td>C6-H5-CH3 or C7-H8</td>
</tr>
</tbody>
</table>

Contact Information:

Sciencelab.com, Inc.
14025 Smith Rd.
Houston, Texas 77396
US Sales: 1-800-901-7247
International Sales: 1-281-441-4400
Order Online: ScienceLab.com
CHEMTREC (24HR Emergency Telephone), call: 1-800-424-9300
International CHEMTREC, call: 1-703-527-3887
For non-emergency assistance, call: 1-281-441-4400

Section 2: Composition and Information on Ingredients

<table>
<thead>
<tr>
<th>Name</th>
<th>CAS #</th>
<th>% by Weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>Toluene</td>
<td>108-88-3</td>
<td>100</td>
</tr>
</tbody>
</table>

Toxicological Data on Ingredients: Toluene: ORAL (LD50): Acute: 636 mg/kg [Rat]. DERMAL (LD50): Acute: 14100 mg/kg [Rabbit]. VAPOR (LC50): Acute: 49000 mg/m 4 hours [Rat]. 440 ppm 24 hours [Mouse].

Section 3: Hazards Identification

Potential Acute Health Effects:
Hazardous in case of skin contact (irritant), of eye contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Potential Chronic Health Effects:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. MUTAGENIC EFFECTS: Not available. TERATOGENIC EFFECTS: Not available. DEVELOPMENTAL TOXICITY: Not available. The substance may be toxic to blood, kidneys, the nervous system, liver, brain, central nervous system (CNS). Repeated or prolonged exposure to the substance can produce target organs damage.

Section 4: First Aid Measures
Eye Contact:
Check for and remove any contact lenses. In case of contact, immediately flush eyes with plenty of water for at least 15 minutes. Get medical attention.

Skin Contact:
In case of contact, immediately flush skin with plenty of water. Cover the irritated skin with an emollient. Remove contaminated clothing and shoes. Wash clothing before reuse. Thoroughly clean shoes before reuse. Get medical attention.

Serious Skin Contact:
Wash with a disinfectant soap and cover the contaminated skin with an anti-bacterial cream. Seek immediate medical attention.

Inhalation:
If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention.

Serious Inhalation:
Evacuate the victim to a safe area as soon as possible. Loosen tight clothing such as a collar, tie, belt or waistband. If breathing is difficult, administer oxygen. If the victim is not breathing, perform mouth-to-mouth resuscitation. WARNING: It may be hazardous to the person providing aid to give mouth-to-mouth resuscitation when the inhaled material is toxic, infectious or corrosive. Seek medical attention.

Ingestion:
Do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person. If large quantities of this material are swallowed, call a physician immediately. Loosen tight clothing such as a collar, tie, belt or waistband.

Serious Ingestion: Not available.

---

Section 5: Fire and Explosion Data

Flammability of the Product: Flammable.

Auto-Ignition Temperature: 480°C (896°F)

Flash Points: CLOSED CUP: 4.4444°C (40°F). (Setaflash) OPEN CUP: 16°C (60.8°F).

Flammable Limits: LOWER: 1.1% UPPER: 7.1%

Products of Combustion: These products are carbon oxides (CO, CO2).

Fire Hazards in Presence of Various Substances:
Flammable in presence of open flames and sparks, of heat. Non-flammable in presence of shocks.

Explosion Hazards in Presence of Various Substances:
Risks of explosion of the product in presence of mechanical impact: Not available. Risks of explosion of the product in presence of static discharge: Not available.

Fire Fighting Media and Instructions:
Flammable liquid, insoluble in water. SMALL FIRE: Use DRY chemical powder. LARGE FIRE: Use water spray or fog.

Special Remarks on Fire Hazards: Not available.

Special Remarks on Explosion Hazards:
Toluene forms explosive reaction with 1,3-dichloro-5,5-dimethyl-2,4-imidazolididione; dinitrogen tetraoxide; concentrated nitric acid, sulfuric acid + nitric acid; N2O4; AgClO4; BrF3; Uranium hexafluoride; sulfur dichloride. Also forms an explosive mixture with tetryltrimethane.

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Section 6: Accidental Release Measures

Small Spill: Absorb with an inert material and put the spilled material in an appropriate waste disposal.
Large Spill:
Toxic flammable liquid, insoluble or very slightly soluble in water. Keep away from heat. Keep away from sources of ignition. Stop leak if without risk. Absorb with DRY earth, sand or other non-combustible material. Do not get water inside container. Do not touch spilled material. Prevent entry into sewers, basements or confined areas; dike if needed. Call for assistance on disposal. Be careful that the product is not present at a concentration level above TLV. Check TLV on the MSDS and with local authorities.

Section 7: Handling and Storage

Precautions:
Keep away from heat. Keep away from sources of ignition. Ground all equipment containing material. Do not ingest. Do not breathe gas/fumes/vapor/spray. Wear suitable protective clothing. In case of insufficient ventilation, wear suitable respiratory equipment. If ingested, seek medical advice immediately and show the container or the label. Avoid contact with skin and eyes. Keep away from incompatibles such as oxidizing agents.

Storage:
Store in a segregated and approved area. Keep container in a cool, well-ventilated area. Keep container tightly closed and sealed until ready for use. Avoid all possible sources of ignition (spark or flame).

Section 8: Exposure Controls/Personal Protection

Engineering Controls:
Provide exhaust ventilation or other engineering controls to keep the airborne concentrations of vapors below their respective threshold limit value. Ensure that eyewash stations and safety showers are proximal to the work-station location.

Personal Protection:
Splash goggles. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Gloves.

Personal Protection in Case of a Large Spill:
Splash goggles. Full suit. Vapor respirator. Boots. Gloves. A self contained breathing apparatus should be used to avoid inhalation of the product. Suggested protective clothing might not be sufficient; consult a specialist BEFORE handling this product.

Exposure Limits:

Section 9: Physical and Chemical Properties

Physical state and appearance: Liquid.
Odor: Sweet, pungent, Benzene-like.
Taste: Not available.
Molecular Weight: 92.14 g/mole
Color: Colorless.

pH (1% soln/water): Not applicable.

Boiling Point: 110.6°C (231.1°F)

Melting Point: -95°C (-139°F)

Critical Temperature: 318.6°C (605.5°F)

Specific Gravity: 0.8636 (Water = 1)
Vapor Pressure: 3.8 kPa (@ 25°C)
Vapor Density: 3.1 (Air = 1)
Volutility: Not available.
Odor Threshold: 1.6 ppm
Water/Oil Dist. Coeff.: The product is more soluble in oil; log(oil/water) = 2.7
Ionicity (in Water): Not available.
Dispersion Properties: See solubility in water, diethyl ether, acetone.
Solubility:
Soluble in diethyl ether, acetone. Practically insoluble in cold water. Soluble in ethanol, benzene, chloroform, glacial acetic acid, carbon disulfide. Solubility in water: 0.561 g/l @ 25 deg. C.

Section 10: Stability and Reactivity Data

Stability: The product is stable.

Instability Temperature: Not available.

Conditions of Instability: Heat, ignition sources (flames, sparks, static), incompatible materials

Incompatibility with various substances: Reactive with oxidizing agents.

Corrosivity: Non-corrosive in presence of glass.

Special Remarks on Reactivity:
Incompatible with strong oxidizers, silver perchlorate, sodium difluoride, Tetranitromethane, Uranium Hexafluoride. Frozen Bromine Trifluoride reacts violently with Toluene at -80 deg. C. Reacts chemically with nitrogen oxides, or halogens to form nitrotoluene, nitrobenzene, and nitrophenol and halogenated products, respectively.

Special Remarks on Corrosivity: Not available.

Polymerization: Will not occur.

Section 11: Toxicological Information

Routes of Entry: Absorbed through skin. Dermal contact. Eye contact. Inhalation. Ingestion.

Toxicity to Animals:
WARNING: THE LC50 VALUES HEREUNDER ARE ESTIMATED ON THE BASIS OF A 4-HOUR EXPOSURE. Acute oral toxicity (LD50): 636 mg/kg [Rat]. Acute dermal toxicity (LD50): 14100 mg/kg [Rabbit]. Acute toxicity of the vapor (LC50): 440 24 hours [Mouse].

Chronic Effects on Humans:
CARCINOGENIC EFFECTS: A4 (Not classifiable for human or animal.) by ACGIH, 3 (Not classifiable for human.) by IARC. May cause damage to the following organs: blood, kidneys, the nervous system, liver, brain, central nervous system (CNS).

Other Toxic Effects on Humans:
Hazardous in case of skin contact (irritant), of ingestion, of inhalation. Slightly hazardous in case of skin contact (permeator).

Special Remarks on Toxicity to Animals:
Lowest Published Lethal Dose: LDL [Human] - Route: Oral; Dose: 50 mg/kg LDL [Rabbit] - Route: Inhalation; Dose: 55000 ppm/40min

Special Remarks on Chronic Effects on Humans:
Detected in maternal milk in human. Passes through the placental barrier in human. Embryotoxic and/or foetotoxic in animal. May cause adverse reproductive effects and birth defects (teratogenic). May affect genetic material (mutagenic)

Special Remarks on other Toxic Effects on Humans:
Acute Potential Health Effects: Skin: Causes mild to moderate skin irritation. It can be absorbed to some extent through the skin. Eyes: Causes mild to moderate eye irritation with a burning sensation. Splash contact with eyes also causes conjunctivitis, blepharospasm, corneal edema, corneal abrasions. This usually resolves in 2 days. Inhalation: Inhalation of vapor may cause respiratory tract irritation causing coughing and wheezing, and nasal discharge. Inhalation of high concentrations may affect behavior and cause central nervous system effects characterized by nausea, headache, dizziness, tremors, restlessness, lightheadedness, exhilaration, memory loss, insomnia, impaired reaction time, drowsiness, ataxia, hallucinations, somnolence, muscle contraction or spasticity, unconsciousness and coma. Inhalation of high concentration of vapor may also affect the cardiovascular system (rapid heart beat, heart palpitations, increased or decreased blood pressure, dysrhythmia, ), respiration (acute pulmonary edema, respiratory depression, apnea, asphyxia), cause vision disturbances and dilated pupils, and cause loss of appetite. Ingestion: Aspiration hazard. Inhalation of Toluene into the lungs may cause chemical pneumonitis. May cause irritation of the digestive tract with nausea, vomiting, pain. May have effects similar to that of acute inhalation. Chronic Potential Health Effects: Inhalation and Ingestion: Prolonged or repeated exposure via inhalation may cause central nervous system and cardiovascular symptoms similar to that of acute inhalation and ingestion as well liver damage/failure, kidney damage/failure (with hematuria, proteinuria, oliguria, renal tubular acidosis), brain damage, weight loss, blood (pigmented or nucleated red blood cells, changes in white blood cell count), bone marrow changes, electrolyte imbalances (Hypokalemia, Hypophosphatemia), severe, muscle weakness and Rhabdomyolysis. Skin: Repeated or prolonged skin contact may cause defatting dermatitis.

Section 12: Ecological Information

Ecotoxicity:
Ecotoxicity in water (LC50): 313 mg/l 48 hours [Daphnia (daphnia)]. 17 mg/l 24 hours [Fish (Blue Gill)]. 13 mg/l 96 hours [Fish (Blue Gill)]. 56 mg/l 24 hours [Fish (Fathead minnow)]. 34 mg/l 96 hours [Fish (Fathead minnow)]. 56.8 ppm any hours [Fish (Goldfish)].

BOD5 and COD: Not available.

Products of Biodegradation:
Possibly hazardous short term degradation products are not likely. However, long term degradation products may arise.

Toxicity of the Products of Biodegradation: The products of degradation are less toxic than the product itself.

Special Remarks on the Products of Biodegradation: Not available.

Section 13: Disposal Considerations

Waste Disposal:
Waste must be disposed of in accordance with federal, state and local environmental control regulations.

Section 14: Transport Information

DOT Classification: CLASS 3: Flammable liquid.
Identification: Toluene UNNA: 1294 PG: II
Special Provisions for Transport: Not available.

Section 15: Other Regulatory Information

Federal and State Regulations:
California prop. 65: This product contains the following ingredients for which the State of California has found to cause cancer, birth defects or other reproductive harm, which would require a warning under the statute: Toluene California prop. 65 (no significant risk level): Toluene: 7 mg/day (value) California prop. 65 (acceptable daily intake level): Toluene: 7 mg/day (value) California prop. 65: This product contains the following ingredients for which the State of California has found to cause birth defects which would require a warning under the statute: Toluene Connecticut hazardous material survey.: Toluene Illinois

Other Regulations:

Other Classifications:
WHMIS (Canada):
CLASS B-2: Flammable liquid with a flash point lower than 37.8°C (100°F). CLASS D-2A: Material causing other toxic effects (VERY TOXIC).

DSCL (EEC):

HMIS (U.S.A.):
Health Hazard:
2
Fire Hazard:
3
Reactivity:
0
Personal Protection: h

National Fire Protection Association (U.S.A.):
Health:
2
Flammability:
3
Reactivity:
0
Specific hazard:

Protective Equipment:
Gloves. Lab coat. Vapor respirator. Be sure to use an approved/certified respirator or equivalent. Wear appropriate respirator when ventilation is inadequate. Splash goggles.

Section 16: Other Information

References: Not available.
Other Special Considerations: Not available.
Created: 10/10/2005 08:30 PM
Last Updated: 11/01/2010 12:00 PM

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Material Safety Data Sheet

HYDROFLUORIC ACID, AQUEOUS (49%)

1. CHEMICAL PRODUCT AND COMPANY IDENTIFICATION

PRODUCT NAME: Hydrofluoric Acid, Aqueous (49%)

OTHER/Generic NAMES: Aqueous HF, Hydrofluoric Acid Solution, 49% HF, Ultra High Purity HF, Electronic Grade HF

PRODUCT USE: Metal Pickling, Glass Etching, Chemical Derivatives, Semiconductor etching

MANUFACTURER: Honeywell International
Industrial Fluorines
101 Columbia Road
Box 1053
Morristown, New Jersey 07962-1053

FOR MORE INFORMATION CALL: (Monday-Friday, 8:00am-4:30pm EST)
HF Technical Service Department
800-622-5002

IN CASE OF EMERGENCY CALL:
(24 Hours/Day, 7 Days/Week)
800-707-4555 or 602-365-4980
For Transportation Emergencies:
800-424-9300 (CHEMTREC for US)
613-996-6666 (CANUTEC for Canada)

2. COMPOSITION/INFORMATION ON INGREDIENTS

<table>
<thead>
<tr>
<th>INGREDIENT NAME</th>
<th>CAS NUMBER</th>
<th>WEIGHT %</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrofluoric Acid</td>
<td>7664-39-3</td>
<td></td>
</tr>
<tr>
<td>Water</td>
<td>7732-18-5</td>
<td></td>
</tr>
</tbody>
</table>

Trace impurities and additional material names not listed above may also appear in the Regulatory Information Section 15 towards the end of the MSDS. These materials may be listed for local "Right-To-Know" compliance and for other reasons.

3. HAZARDS IDENTIFICATION

EMERGENCY OVERVIEW: Clear, colorless, corrosive fuming liquid with an extremely acid odor. May produce white fumes if spilled. Both liquid and vapor can cause severe burns to all parts of the body. Specialized medical treatment is required for all exposures.

MSDS Number: HF-0013
Current Issue Date: February, 2002
MATERIAL SAFETY DATA SHEET
Hydrofluoric Acid, Aqueous (49%)

POTENTIAL HEALTH HAZARDS

SKIN: Both liquid and vapor can cause severe burns, which may not be immediately painful or visible. HF will penetrate skin and attack underlying tissues. Large or multiple burns totaling over 25 square inches of body surface area may also cause hypocalcemia (depletion of calcium in the body) and other toxic effects which may be fatal. Prolonged contact with very dilute HF solutions will cause burns.

EYES: Both liquid and vapor can cause irritation or corneal burns.

INHALATION: Mild exposure: Can irritate nose, throat and respiratory system. Onset of symptoms may be delayed for several hours.

Severe exposure: Can cause nose and throat burns, lung inflammation and pulmonary edema (fluid in the lungs). Also results in other toxic effects including hypocalcemia (depletion of calcium in the body) which if not properly treated can result in death.

INGESTION: Can cause severe mouth, throat and stomach burns and may be fatal if swallowed. Even with small amounts of dilute solutions, profound and possibly fatal hypocalcemia (depletion of calcium in body) and systematic toxicity is likely to occur unless medical treatment is promptly initiated.

DELAYED EFFECTS: The effects of contact with dilute solutions of hydrofluoric acid or its vapors may be delayed. The potential delay in clinical signs or symptoms for dilute solutions is given below:

<table>
<thead>
<tr>
<th>HF Concentration</th>
<th>Delay in Symptoms</th>
</tr>
</thead>
<tbody>
<tr>
<td>&gt;50%</td>
<td>Immediately Apparent</td>
</tr>
<tr>
<td>20%-50%</td>
<td>1-8 hours</td>
</tr>
<tr>
<td>0%-20%</td>
<td>Up to 24 hours</td>
</tr>
</tbody>
</table>

Can also cause bone and joint changes in humans (Fluorosis).

Carcinogenicity: Hydrofluoric Acid is not listed by NTP, IARC, OSHA or ACGIH as a carcinogen.

4. FIRST AID MEASURES

SKIN: Remove the victim from the contaminated area and immediately wash the burned area with plenty of water for a minimum of 15 minutes. Limit washing to 5 minutes if treatment specific for HF exposure is available. Remove all contaminated clothing while washing continuously. After thorough washing for at least 5 minutes, the burned area should be immersed in a solution of 0.13% iced aqueous Zephiran® Chloride until pain is relieved. As an alternate first aid treatment, 2.5% calcium gluconate gel may be continuously massaged into the burn area until the pain is relieved. For larger burns or burns treated with calcium gluconate gel (in which pain is present longer than 30 minutes), a physician should inject 5% aqueous calcium gluconate beneath, around and in the burned area. Use of local anesthetics is not recommended, as reduction in pain is an indicator of effectiveness of treatment.
MATERIAL SAFETY DATA SHEET
Hydrofluoric Acid, Aqueous (49%)

EYES: Irrigate eyes for at least 15 minutes with copious quantities of water, keeping eyelids apart and away from eyeballs during irrigation. Get competent medical attention immediately, preferably an eye specialist. If a physician is not immediately available, apply one or two drops of 0.5% tetracaine hydrochloride solution, or other aqueous topical ophthalmic anesthetic and continue irrigation. Do not use the solution described for skin treatment. Use no oils or greases unless instructed to do so by a physician. Irrigate with 1% calcium gluconate in normal saline for 1 to 2 hours to prevent or lessen corneal damage.

INHALATION: Move to fresh air. Keep the victim lying down, quiet and warm. Get competent medical attention immediately. If breathing has stopped, start artificial respiration at once. An authorized person should administer oxygen to a victim who is having difficulty breathing, until the victim is able to breathe easily by himself. Do not give stimulants unless instructed to do so by a physician. Victim should be examined by a physician and held under observation for at least 24 hours. Calcium Gluconate, 2.5% in normal saline may be given by nebulizer with oxygen.

INGESTION: Drink large amounts of water to dilute. Do not induce vomiting. Several glasses of milk or several ounces of milk of magnesia may be given for their soothing effect. Take victim to a doctor.

ADVICE TO PHYSICIAN: For burns of large skin areas (greater than 25 square inches), for ingestion and for significant inhalation exposure, severe systemic effects may occur. Monitor and correct for hypocalcemia, cardiac arrhythmias, hypomagnesemia and hyperkalemia. In some cases renal dialysis may be indicated. For certain burns, especially of the digits, use of intra-arterial calcium gluconate may be indicated. For inhalation exposures, treat as chemical pneumonia. Monitor for hypocalcemia. 2.5% calcium gluconate in normal saline by nebulizer or by IPPB with 100% oxygen may decrease pulmonary damage. Bronchodilators may also be administered.

5. FIRE FIGHTING MEASURES

FLAMMABLE PROPERTIES

FLASH POINT: Not flammable
FLASH POINT METHOD: Closed cup
AUTOIGNITION TEMPERATURE: Not applicable
UPPER FLAME LIMIT (volume % in air): Not applicable
LOWER FLAME LIMIT (volume % in air): Not applicable
FLAME PROPAGATION RATE (solids): Not applicable
OSHA FLAMMABILITY CLASS: Not applicable

EXTINGUISHING MEDIA:
Use water or suitable agent for fires adjacent to non-leaking tanks or containers of HF. Do not use solid water streams near ruptured tanks or spills of HF. Acid reacts with water and can splatter acid onto personnel.

UNUSUAL FIRE AND EXPLOSION HAZARDS:
Reaction with certain metals generates flammable and potentially explosive hydrogen gas. Considerable heat is evolved when contacted with many substances. Heat increases pressure and may explode container. Will react violently with water.

SPECIAL FIRE FIGHTING PRECAUTIONS/INSTRUCTIONS:
Wear self-contained breathing apparatus approved by NIOSH and full chemical protective clothing. Use water spray to keep containers cool.
MATERIAL SAFETY DATA SHEET
Hydrofluoric Acid, Aqueous (49%)

6. ACCIDENTAL RELEASE MEASURES

IN CASE OF SPILL OR OTHER RELEASE: (Always wear recommended personal protective equipment)
Good ventilation is necessary. Discharge will ordinarily be a vapor or a liquid that gives off fumes of HF
gas. Those treating spills or repairing leaks must use full protective equipment. Take actions to minimize
environmental impact. Try to contain spillage and avoid drainage to areas which cannot be treated. Rapid dilution of
the spill with water will reduce the amount of fumes given off.
Carefully neutralize the dilute liquid with lime slurry, soda ash, limestone, caustic soda or other alkaline material.
(See Sections 10 and 13 for more information.)

Spills and releases may have to be reported to Federal and/or local authorities. See Section 15 regarding
reporting requirements.

7. HANDLING AND STORAGE

NORMAL HANDLING: (Always wear recommended personal protective equipment.)
Do not breathe vapor or mist. Use only with adequate ventilation. Avoid all contact with skin, eyes and
clothing, even dilute solutions. Do not add water to acid.

STORAGE RECOMMENDATIONS:
Store in approved containers only. Store in cool, well-ventilated area. Flammable hydrogen gas can be
generated in contact with metals. Diking of storage tanks is recommended.

8. EXPOSURE CONTROLS/PERSONAL PROTECTION

ENGINEERING CONTROLS:
Sufficient to reduce vapor and acid mists below permissible TLV levels. Packaging and unloading areas and open
processing equipment may require mechanical exhaust systems.

PERSONAL PROTECTIVE EQUIPMENT

SKIN PROTECTION:
For routine product use, wear hydrofluoric acid-resistant jacket, trousers, boots and gauntlet gloves. For
increased protection, use air-supplied totally encapsulating HF resistant protective suit.

EYE PROTECTION:
As a minimum, wear hard hat, chemical safety goggles (plastic lenses), and full face plastic shield.
For increased protection, use air-supplied hydrofluoric acid resistant hood.

RESPIRATORY PROTECTION:
Where required, use a respirator approved by NIOSH for HF gas or mists, as applicable. Some
exposures may require a NIOSH-approved, self-contained breathing apparatus or air supplied
respirator.

ADDITIONAL RECOMMENDATIONS:
Eyewash and quick-drench shower facilities, protected from freezing, should be available where
HF is stored or handled.

MSDS Number: HF-0013
Current Issue Date: February, 2002
Material Safety Data Sheet
Hydrofluoric Acid, Aqueous (49%)

Exposure Guidelines

<table>
<thead>
<tr>
<th>Ingredient Name</th>
<th>ACGIH TLV</th>
<th>OSHA PEL</th>
<th>Other Limit</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrofluoric Acid</td>
<td>3 ppm – CEILING</td>
<td>3 ppm (TWA)</td>
<td>3 mg(F)/g creatinine in urine pre-shift</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td>10 mg(F)/g creatinine post-shift***</td>
</tr>
</tbody>
</table>

OSHA STEL: 6 ppm (15 min.)

IDLH: 30 ppm

AIHA Emergency Response Planning Guideline
ERPG-1: 2 ppm
ERPG-2: 20 ppm
ERPG-3: 50 ppm

*** = Biological Exposure Index

Other Exposure Limits for Potential Decomposition Products: None

9. Physical and Chemical Properties

Appearance: Colorless liquid, fumes in air
Physical State: Liquid
Molecular Weight: 20.01 (HF)
Chemical Formula: 49% HF in water by weight
Odor: Sharp pungent odor
Specific Gravity: (Water = 1.0) 1.175 at 60°F, (15.5°C) 1.16 at 80°F (26.6°C)
Solubility in Water: (Weight %) 100% by weight
pH: Not applicable
Boiling Point: 224°F (106°C)
Melting Point: -34°F (-37°C)
Vapor Pressure: 27 mm Hg at 70°F (21°C)
Vapor Density (Air = 1.0): 2.21 @ 70°F, 1.76 @ 80°F
Evaporation Rate: Not applicable
% Volatiles: Unknown
Ionization Potential: 15.98 eV
Flash Point: Not flammable.
(Flash point method and additional flammability data are found in section 5.)

10. Stability and Reactivity

 Normally Stable? (Conditions to Avoid): Stable under normal conditions.

Incompatibilities: Glass, concrete and other silicon bearing materials: yield silicon tetrafluoride gas. Pressure buildup from this process has been known to blow up glass containers. Carbonates, sulfides, and cyanides: yield toxic gases: carbon dioxide, hydrogen sulfide and hydrogen cyanide. Alkalis, some oxides: cause strong violent exothermic reactions. Common metals: yield hydrogen gas, a fire and explosive reaction hazard. Corrosive to many materials including natural leather, rubber and many organics. Considerable heat is evolved and a violent reaction can occur when water is added to HF.
MATERIAL SAFETY DATA SHEET
Hydrofluoric Acid, Aqueous (49%)

HAZARDOUS DECOMPOSITION PRODUCTS:
Not applicable; boils away as hydrogen fluoride gas and water.

HAZARDOUS POLYMERIZATION: Will not occur.

11. TOXICOLOGICAL INFORMATION

IMMEDIATE (ACUTE) EFFECTS:
Inhalation: LC₅₀ (Rat) = 5,100 ppm/5 min
LC₅₀ (Rat) = 1,300 ppm/60 min
LC₅₀ (Mouse) = 6,247 ppm/5 min

Skin: 2% solution of HF was corrosive to rabbit skin with 1 hour exposure, but not with 1 minute exposure.

DELAYED (SUBCHRONIC AND CHRONIC) EFFECTS:
Prolonged exposure can cause bone and joint changes in humans. (Fluorosis – Increased bone density and mottling of teeth)

OTHER DATA: None

12. ECOLOGICAL INFORMATION

Aquatic toxicity: 60 ppm/*/fish/lethal/fresh water. (*time period not specified).

13. DISPOSAL CONSIDERATIONS

RCRA

Is the unused product a RCRA hazardous waste if discarded? Yes
If yes, the RCRA ID number is: U134 (hydrofluoric acid) and D002 (Corrosive)

OTHER DISPOSAL CONSIDERATIONS: As waste disposal methods may vary, contact the supplier for specific recommendations. Treat small amounts by adding to an excess of water and neutralize with lime slurry, soda ash, limestone, caustic soda or other alkali. Add to water and neutralize cautiously as reaction is immediate and can be violent. Considerable amounts of harmful vapors may be released. Good ventilation is required. Dispose of residue (or slurry) by removal to an approved chemical waste landfill or by an approved waste contractor.

The information offered here is for the product as shipped. Use and/or alterations to the product such as mixing with other materials may significantly change the characteristics of the material and alter the RCRA classification and the proper disposal method.

14. TRANSPORT INFORMATION

US DOT HAZARD CLASS: CLASS 8 (CORROSIVE), PACKING GROUP, PG II, POISON
PROPER SHIPPING NAME: RQ, HYDROFLUORIC ACID (for quantities greater than 204 lbs.)
US DOT ID NUMBER: UN 1790
UN 1790 (PIN # in Canada)
MATERIAL SAFETY DATA SHEET
Hydrofluoric Acid, Aqueous (49%)

For additional information on shipping regulations affecting this material, contact the information number found in Section 1.

15. REGULATORY INFORMATION

TOXIC SUBSTANCES CONTROL ACT (TCSA)

TSCA INVENTORY STATUS: Hydrofluoric Acid, Aqueous is listed.

OTHER TSCA ISSUES: None

SARA TITLE III/CERCLA:

RQs and TPQs:
"Reportable Quantities" (RQs) and/or "Threshold Planning Quantities" (TPQs) exist for the following ingredients.

<table>
<thead>
<tr>
<th>INGREDIENT NAME</th>
<th>SARA/CERCLA RQ (lbs)</th>
<th>SARA EHS TPQ (lbs)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrofluoric Acid</td>
<td>100 as 100% HF</td>
<td>100 as 100% HF</td>
</tr>
</tbody>
</table>

Spills or releases resulting in the loss of any ingredient at or above its RQ requires immediate notification to the National Response Center [(800) 424-8802] and to your Local Emergency Planning Committee.

SECTION 311 HAZARD CLASS: Immediate. Delayed

SARA 313 TOXIC CHEMICALS:

The following ingredients are SARA 313 "Toxic Chemicals". CAS numbers and weight percents are found in Section 2.

<table>
<thead>
<tr>
<th>INGREDIENT NAME</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hydrofluoric Acid</td>
<td>None</td>
</tr>
</tbody>
</table>

STATE RIGHT-TO-KNOW

In addition to the ingredients found in Section 2, the following are listed for state right-to-know purposes.

<table>
<thead>
<tr>
<th>INGREDIENT NAME</th>
<th>WEIGHT %</th>
<th>COMMENT</th>
</tr>
</thead>
<tbody>
<tr>
<td>No ingredients in this section</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

ADDITIONAL REGULATORY INFORMATION: None
MATERIAL SAFETY DATA SHEET
Hydrofluoric Acid, Aqueous (49%)

WHMIS CLASSIFICATION (CANADA):
Class D, Division 1, Subdivision A and
Class E

This product has been classified in accordance with the hazard criteria of the CPR and the MSDS contains all the information required by the CPR.

FOREIGN INVENTORY STATUS:
Canadian DSL (Domestic Substances List)
EINECS (European Inventory of Existing Chemical Substances) (EINECS #:231-634-8)

16. OTHER INFORMATION

CURRENT ISSUE DATE: January, 2002
PREVIOUS ISSUE DATE: January, 2001

CHANGES TO MSDS FROM PREVIOUS ISSUE DATE ARE DUE TO THE FOLLOWING:
Minor wording changes in Sections 1,3,4,6,7,8,10, & 13 for clarification. (Jan ’02)

OTHER INFORMATION: National Fire Prevention Association (NFPA) Rating
Health 4, Flammability 0, Reactivity 1, Special Instruction – None
Hazardous Materials Information System (HMIS) Rating
Health 3, Flammability 0, Reactivity 1, Personal Protective Equipment - X
Sample Hazardous Chemical Communication Program

A. Company Policy

(Name of employer) is committed to the prevention of exposures that result in injury and/or illness; and to comply with all applicable state health and safety rules. To make sure that all affected employees know about information concerning the dangers of all hazardous chemicals used by (Name of employer), the following hazardous information program has been established.

All work units of (Name of employer) will participate in the hazard communication program. This written program will be available in (Specify the location) for review by any interested employee.

B. Container Labeling

(Name of person and position) is responsible for container labeling procedures, reviewing, and updating. The labeling system used at (Name of employer) is as follows:

(Describe the labeling system, including the labels or other forms of warning used, and written alternatives to labeling, if any.)

The procedures for proper labeling of all containers, and reviewing and updating label warnings are as follows:

(Also include a description of the procedures for labeling of secondary containers used, including making sure that they have the appropriate identification and hazard warning, etc.; description of procedures for reviewing and updating label warnings, how often the review is conducted, and the name of the person and position who is responsible for reviewing and updating label warnings.)

It is the policy of (Name of employer) that no container will be released for use until the above procedures are followed.
Sample Hazardous Chemical Communication Program

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It is the policy of (Name of employer) that no container will be released for use until the above procedures are followed.
C. Material Safety Data Sheets (MSDS)

(Name of person and position) is responsible to establish and monitor the employer’s MSDS program. This person will make sure procedures are developed to obtain the necessary MSDSs and will review incoming MSDSs for new or significant health and safety information. This person will see that any new information is passed on to affected employees.

The procedures to obtain MSDSs and review incoming MSDSs for new or significant health and safety information are as follows:

(Include procedures on how to make sure copies are current and updated, how any new information is passed on to affected employees, and the procedures for employee access in work areas.)

Copies of MSDSs for all hazardous chemicals in use will be kept in (Specify the location). MSDSs will be available to all employees during each work shift. If an MSDS is not available or a new chemical in use does not have an MSDS, immediately contact (The person and position).

Note:

If an alternative to printed Material Safety Data Sheets is used (such as computer data), provide a description of the format.

D. Employee Information and Training

(Name of person and position) is responsible for the employer/employee training program.

The procedures for how employees will be informed and trained are as follows:

(Include the methods used for general and site-specific training, and how employees will be informed when non-routine tasks arise. If your employees work at other employers’ job sites, then specify where and how these employees will have access to MSDSs and labels, and how they will be informed of precautionary measures to take during normal or emergency operations, if any.)
Sample Hazardous Chemical Communication Program

- An overview of the requirements contained in the Hazard Communication Standard.
- Hazardous chemicals present at his or her work places.
- Physical and health risks of the hazardous chemical.
- The symptoms of overexposure.
- How to determine the presence or release of hazardous chemicals in his or her work area.
- How to reduce or prevent exposure to hazardous chemicals through use of control procedures, work practices, and personal protective equipment.
- Steps the employer has taken to reduce or prevent exposure to hazardous chemicals.
- Procedures to follow if employees are overexposed to hazardous chemicals.
- How to read labels and review MSDSs to obtain hazard information.
- Location of the MSDS file and written hazard communication program.

Before introducing a new chemical hazard into any section of this employer, each employee in that section will be given information and training as outlined above for the new chemical.

E. Hazardous non-routine tasks

Periodically, employees are required to perform hazardous non-routine tasks. (Some examples of non-routine tasks are confined space entry, tank cleaning, and painting reactor vessels.) Non-routine tasks that are performed at ______ (Name of employer) include

1. __________________________________________________________________________
2. __________________________________________________________________________
3. __________________________________________________________________________

Prior to starting work on such projects, each affected employee will be given information by ______ (Name of person and position) about the hazardous chemicals he or she may encounter during these activities:

(For each activity, list the specific chemical hazards, protective and safety measures the employee can use, and the steps the employer has taken to reduce the hazards, including ventilation, respirators, presence of another employee, and emergency procedures.)

____________________________________________________________________________
____________________________________________________________________________
____________________________________________________________________________
Sample Hazardous Chemical Communication Program

The sample labels on the following page show the type of information you must list on containers of hazardous chemicals. You can copy and use these labels or you can make your own.

Be sure your labels contain the following information:

• Name of Chemical
• Physical Hazards
• Health Hazards, Target Organs or Systems
• Optional information, such as Personal Protective Equipment or Safe Handling

After you’ve finished typing or writing in your information, print the labels. Then, cut out the individual labels and apply them to your hazardous chemical containers.
Sample Labels for Hazardous Chemical Containers

<table>
<thead>
<tr>
<th>Name of Chemical or Common Name</th>
<th>Name of Chemical or Common Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Physical Hazards</td>
<td>Physical Hazards</td>
</tr>
<tr>
<td>Health Hazards, Target Organs or Systems</td>
<td>Health Hazards, Target Organs or Systems</td>
</tr>
<tr>
<td>Optional Information, such as Personal Protective Equipment or Safe Handling</td>
<td>Optional Information, such as Personal Protective Equipment or Safe Handling</td>
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<tr>
<td>Optional Information, such as Personal Protective Equipment or Safe Handling</td>
<td>Optional Information, such as Personal Protective Equipment or Safe Handling</td>
</tr>
</tbody>
</table>
Appendix D: Sample Chemical Spill Plan

United Construction Ltd.
Last revision October 2011

Locations of spill control and clean up equipment

Spill control equipment will be located on each floor by each access way and maintenance closet.

Personal Protective Equipment (PPE):
Follow recommendations outlined in chemicals MSDS

When a Large Chemical Spill has occurred (greater than 10 square feet for low hazard/toxic chemicals or highly hazards/toxic chemicals contact spill control or dial 911):

- Immediately notify your immediate supervisor and Emergency Coordinator
- Contain the spill with available equipment if qualified and safe to do so (e.g., pads, booms, absorbent powder, etc.)
- Secure the area if qualified and alert other site personnel
- Do not attempt to clean the spill unless trained to do so and proper equipment is available and you deem it safe
- Attend to injured personnel and call the medical emergency number
- Call a local spill cleanup company or the Fire Department (if arrangement has been made) to perform a large chemical (e.g., mercury) spill cleanup

Name of Spill Cleanup Company: QuickKlean Hazmat Control, Inc.
Phone Number: 555-555-5555

- Evacuate building as necessary
When a Small Chemical Spill has occurred (less than 10 square feet for low hazard/toxic chemicals):

- Notify your immediate supervisor
- If toxic gases or vapors are present, secure the area (with caution tapes or cones) to prevent other personnel from entering
- Deal with the spill in accordance with the instructions described in the MSDS
- Small spills must be handled in a safe manner, while wearing the proper PPE and using MSDS prescribed equipment
- Review the general spill cleanup procedures

When in doubt, call for emergency response by dialing 911
Appendix E: OSHA Standard 1910.1200

<table>
<thead>
<tr>
<th>Part Number:</th>
<th>1910</th>
</tr>
</thead>
<tbody>
<tr>
<td>• Part Title:</td>
<td>Occupational Safety and Health Standards</td>
</tr>
<tr>
<td>• Subpart:</td>
<td>Z</td>
</tr>
<tr>
<td>• Subpart Title:</td>
<td>Toxic and Hazardous Substances</td>
</tr>
<tr>
<td>• Standard Number:</td>
<td>1910.1200</td>
</tr>
<tr>
<td>• Title:</td>
<td>Hazard Communication.</td>
</tr>
<tr>
<td>• Appendix:</td>
<td>A, B, C, D, E</td>
</tr>
</tbody>
</table>

**1910.1200(a)**

"Purpose."

**1910.1200(a)(1)**

The purpose of this section is to ensure that the hazards of all chemicals produced or imported are evaluated, and that information concerning their hazards is transmitted to employers and employees. This transmittal of information is to be accomplished by means of comprehensive hazard communication programs, which are to include container labeling and other forms of warning, material safety data sheets and employee training.

**..1910.1200(a)(2)**

**1910.1200(a)(2)**

This occupational safety and health standard is intended to address comprehensively the issue of evaluating the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees, and to preempt any legal requirements of a state, or political subdivision of a state, pertaining to this subject. Evaluating the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees, may include, for example, but is not limited to, provisions for: developing and maintaining a written hazard communication program for the workplace, including lists of hazardous chemicals present; labeling of containers of chemicals in the workplace, as well as of...
containers of chemicals being shipped to other workplaces; preparation and distribution of material safety data sheets to employees and downstream employers; and development and implementation of employee training programs regarding hazards of chemicals and protective measures. Under section 18 of the Act, no state or political subdivision of a state may adopt or enforce, through any court or agency, any requirement relating to the issue addressed by this Federal standard, except pursuant to a Federally-approved state plan.

1910.1200(b)

"Scope and application."

1910.1200(b)(1)

This section requires chemical manufacturers or importers to assess the hazards of chemicals which they produce or import, and all employers to provide information to their employees about the hazardous chemicals to which they are exposed, by means of a hazard communication program, labels and other forms of warning, material safety data sheets, and information and training. In addition, this section requires distributors to transmit the required information to employers. (Employers who do not produce or import chemicals need only focus on those parts of this rule that deal with establishing a workplace program and communicating information to their workers. Appendix E of this section is a general guide for such employers to help them determine their compliance obligations under the rule.)

1910.1200(b)(2)

This section applies to any chemical which is known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency.

1910.1200(b)(3)

This section applies to laboratories only as follows:

1910.1200(b)(3)(i)

Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

1910.1200(b)(3)(ii)

Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible during each workshift to laboratory employees when they are in their work areas;
Employers shall ensure that laboratory employees are provided information and training in accordance with paragraph (h) of this section, except for the location and availability of the written hazard communication program under paragraph (h)(2)(iii) of this section; and,

1910.1200(b)(3)(iv)

Laboratory employers that ship hazardous chemicals are considered to be either a chemical manufacturer or a distributor under this rule, and thus must ensure that any containers of hazardous chemicals leaving the laboratory are labeled in accordance with paragraph (f)(1) of this section, and that a material safety data sheet is provided to distributors and other employers in accordance with paragraphs (g)(6) and (g)(7) of this section.

1910.1200(b)(4)

In work operations where employees only handle chemicals in sealed containers which are not opened under normal conditions of use (such as are found in marine cargo handling, warehousing, or retail sales), this section applies to these operations only as follows:

1910.1200(b)(4)(i)

Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

1910.1200(b)(4)(ii)

Employers shall maintain copies of any material safety data sheets that are received with incoming shipments of the sealed containers of hazardous chemicals, shall obtain a material safety data sheet as soon as possible for sealed containers of hazardous chemicals received without a material safety data sheet if an employee requests the material safety data sheet, and shall ensure that the material safety data sheets are readily accessible during each work shift to employees when they are in their work area(s); and,

1910.1200(b)(4)(iii)

Employers shall ensure that employees are provided with information and training in accordance with paragraph (h) of this section (except for the location and availability of the written hazard communication program under paragraph (h)(2)(iii) of this section), to the extent necessary to protect them in the event of a spill or leak of a hazardous chemical from a sealed container.

1910.1200(b)(5)

This section does not require labeling of the following chemicals:

1910.1200(b)(5)(i)

Any pesticide as such term is defined in the Federal Insecticide, Fungicide, and Rodenticide Act (7
U.S.C. 136 et seq.), when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Environmental Protection Agency;

1910.1200(b)(5)(i)

Any chemical substance or mixture as such terms are defined in the Toxic Substances Control Act (15 U.S.C. 2601 et seq.), when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Environmental Protection Agency;

..1910.1200(b)(5)(iii)

1910.1200(b)(5)(iii)

Any food, food additive, color additive, drug, cosmetic, or medical or veterinary device or product, including materials intended for use as ingredients in such products (e.g. flavors and fragrances), as such terms are defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.) or the Virus-Serum-Toxin Act of 1913 (21 U.S.C. 151 et seq.), and regulations issued under those Acts, when they are subject to the labeling requirements under those Acts by either the Food and Drug Administration or the Department of Agriculture;

1910.1200(b)(5)(iv)

Any distilled spirits (beverage alcohols), wine, or malt beverage intended for nonindustrial use, as such terms are defined in the Federal Alcohol Administration Act (27 U.S.C. 201 et seq.) and regulations issued under that Act, when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Bureau of Alcohol, Tobacco, and Firearms;

1910.1200(b)(5)(v)

Any consumer product or hazardous substance as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq.) and Federal Hazardous Substances Act (15 U.S.C. 1261 et seq.) respectively, when subject to a consumer product safety standard or labeling requirement of those Acts, or regulations issued under those Acts by the Consumer Product Safety Commission; and,

1910.1200(b)(5)(vi)

Agricultural or vegetable seed treated with pesticides and labeled in accordance with the Federal Seed Act (7 U.S.C. 1551 et seq.) and the labeling regulations issued under that Act by the Department of Agriculture.

..1910.1200(b)(6)
1910.1200(b)(6)

This section does not apply to:

1910.1200(b)(6)(i)

Any hazardous waste as such term is defined by the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6901 et seq.), when subject to regulations issued under that Act by the Environmental Protection Agency;

1910.1200(b)(6)(ii)

Any hazardous substance as such term is defined by the Comprehensive Environmental Response, Compensation and Liability ACT (CERCLA) (42 U.S.C. 9601 et seq.) when the hazardous substance is the focus of remedial or removal action being conducted under CERCLA in accordance with the Environmental Protection Agency regulations.

1910.1200(b)(6)(iii)

Tobacco or tobacco products;

1910.1200(b)(6)(iv)

Wood or wood products, including lumber which will not be processed, where the chemical manufacturer or importer can establish that the only hazard they pose to employees is the potential for flammability or combustibility (wood or wood products which have been treated with a hazardous chemical covered by this standard, and wood which may be subsequently sawed or cut, generating dust, are not exempted);

1910.1200(b)(6)(v)

Articles (as that term is defined in paragraph (c) of this section);

1910.1200(b)(6)(vi)

Food or alcoholic beverages which are sold, used, or prepared in a retail establishment (such as a grocery store, restaurant, or drinking place), and foods intended for personal consumption by employees while in the workplace;

1910.1200(b)(6)(vii)

Any drug, as that term is defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.), when it is in solid, final form for direct administration to the patient (e.g., tablets or pills); drugs which are packaged by the chemical manufacturer for sale to consumers in a retail establish-
ment (e.g., over-the-counter drugs); and drugs intended for personal consumption by employees while in the workplace (e.g., first aid supplies);

1910.1200(b)(6)(viii)

Cosmetics which are packaged for sale to consumers in a retail establishment, and cosmetics intended for personal consumption by employees while in the workplace;

1910.1200(b)(6)(ix)

Any consumer product or hazardous substance, as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq.) and Federal Hazardous Substances Act (15 U.S.C. 1261 et seq.) respectively, where the employer can show that it is used in the workplace for the purpose intended by the chemical manufacturer or importer of the product, and the use results in a duration and frequency of exposure which is not greater than the range of exposures that could reasonably be experienced by consumers when used for the purpose intended;

1910.1200(b)(6)(x)

Nuisance particulates where the chemical manufacturer or importer can establish that they do not pose any physical or health hazard covered under this section;

1910.1200(b)(6)(xi)

Ionizing and nonionizing radiation; and,

1910.1200(b)(6)(xii)

Biological hazards.

1910.1200(c)

"Definitions."

"Article" means a manufactured item other than a fluid or particle: (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical (as determined under paragraph (d) of this section), and does not pose a physical hazard or health risk to employees.

"Assistant Secretary" means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.
"Chemical" means any element, chemical compound or mixture of elements and/or compounds.

"Chemical manufacturer" means an employer with a workplace where chemical(s) are produced for use or distribution.

"Chemical name" means the scientific designation of a chemical in accordance with the nomenclature system developed by the International Union of Pure and Applied Chemistry (IUPAC) or the Chemical Abstracts Service (CAS) rules of nomenclature, or a name which will clearly identify the chemical for the purpose of conducting a hazard evaluation.

"Combustible liquid" means any liquid having a flashpoint at or above 100 deg. F (37.8 deg. C), but below 200 deg. F (93.3 deg. C), except any mixture having components with flashpoints of 200 deg. F (93.3 deg. C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

"Commercial account" means an arrangement whereby a retail distributor sells hazardous chemicals to an employer, generally in large quantities over time and/or at costs that are below the regular retail price.

"Common name" means any designation or identification such as code name, code number, trade name, brand name or generic name used to identify a chemical other than by its chemical name.

"Compressed gas" means:

(i) A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70 deg. F (21.1 deg. C); or

(ii) A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 deg. F (54.4 deg. C) regardless of the pressure at 70 deg. F (21.1 deg. C); or

(iii) A liquid having a vapor pressure exceeding 40 psi at 100 deg. F (37.8 deg. C) as determined by ASTM D-323-72.

"Container" means any bag, barrel, bottle, box, can, cylinder, drum, reaction vessel, storage tank, or the like that contains a hazardous chemical. For purposes of this section, pipes or piping systems, and engines, fuel tanks, or other operating systems in a vehicle, are not considered to be containers.

"Designated representative" means any individual or organization to whom an employee gives written authorization to exercise such employee’s rights under this section. A recognized or certified collective bargaining agent shall be treated automatically as a designated representative without regard to written employee authorization.

"Director" means the Director, National Institute for Occupational Safety and Health, U.S. Department of Health and Human Services, or designee.

"Distributor" means a business, other than a chemical manufacturer or importer, which supplies
hazardous chemicals to other distributors or to employers.

"Employee" means a worker who may be exposed to hazardous chemicals under normal operating conditions or in foreseeable emergencies. Workers such as office workers or bank tellers who encounter hazardous chemicals only in non-routine, isolated instances are not covered.

"Employer" means a person engaged in a business where chemicals are either used, distributed, or are produced for use or distribution, including a contractor or subcontractor.

"Explosive" means a chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

"Exposure or exposed" means that an employee is subjected in the course of employment to a chemical that is a physical or health hazard, and includes potential (e.g. accidental or possible) exposure. "Subjected" in terms of health hazards includes any route of entry (e.g. inhalation, ingestion, skin contact or absorption.)

"Flammable" means a chemical that falls into one of the following categories:

(i) "Aerosol, flammable" means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame projection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening;

(ii) "Gas, flammable" means: (A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of thirteen (13) percent by volume or less; or
(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than twelve (12) percent by volume, regardless of the lower limit;

(iii) "Liquid, flammable" means any liquid having a flashpoint below 100 deg. F (37.8 deg. C), except any mixture having components with flashpoints of 100 deg. F (37.8 deg. C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

(iv) "Solid, flammable" means a solid, other than a blasting agent or explosive as defined in 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

"Flashpoint" means the minimum temperature at which a liquid gives off a vapor in sufficient concentration to ignite when tested as follows:

(i) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24-1979 (ASTM D 56-79)) for liquids with a viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 deg. F (37.8 deg. C), that do not contain suspended solids and do not
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have a tendency to form a surface film under test; or

(ii) Pensky-Martens Closed Tester (see American National Standard Method of Test for Flash Point by Pensky-Martens Closed Tester, Z11.7-1979 (ASTM D 93-79)) for liquids with a viscosity equal to or greater than 45 SUS at 100 deg. F (37.8 deg. C), or that contain suspended solids, or that have a tendency to form a surface film under test; or

(iii) Setaflash Closed Tester (see American National Standard Method of Test for Flash Point by Setaflash Closed Tester (ASTM D 3278-78)).

Organic peroxides, which undergo autoaccelerating thermal decomposition, are excluded from any of the flashpoint determination methods specified above.

"Foreseeable emergency" means any potential occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment which could result in an uncontrolled release of a hazardous chemical into the workplace.

"Hazardous chemical" means any chemical which is a physical hazard or a health hazard.

"Hazard warning" means any words, pictures, symbols, or combination thereof appearing on a label or other appropriate form of warning which convey the specific physical and health hazard(s), including target organ effects, of the chemical(s) in the container(s). (See the definitions for "physical hazard" and "health hazard" to determine the hazards which must be covered.)

"Health hazard" means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes. Appendix A provides further definitions and explanations of the scope of health hazards covered by this section, and Appendix B describes the criteria to be used to determine whether or not a chemical is to be considered hazardous for purposes of this standard.

"Identity" means any chemical or common name which is indicated on the material safety data sheet (MSDS) for the chemical. The identity used shall permit cross-references to be made among the required list of hazardous chemicals, the label and the MSDS.

"Immediate use" means that the hazardous chemical will be under the control of and used only by the person who transfers it from a labeled container and only within the work shift in which it is transferred.

"Importer" means the first business with employees within the Customs Territory of the United States which receives hazardous chemicals produced in other countries for the purpose of supplying them to distributors or employers within the United States.

"Label" means any written, printed, or graphic material displayed on or affixed to containers of haz-
ardous chemicals.

"Material safety data sheet (MSDS)" means written or printed material concerning a hazardous chemical which is prepared in accordance with paragraph (g) of this section.

"Mixture" means any combination of two or more chemicals if the combination is not, in whole or in part, the result of a chemical reaction.

"Organic peroxide" means an organic compound that contains the bivalent -O-O-structure and which may be considered to be a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms has been replaced by an organic radical.

"Oxidizer" means a chemical other than a blasting agent or explosive as defined in 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

"Physical hazard" means a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

"Produce" means to manufacture, process, formulate, blend, extract, generate, emit, or repackage.

"Pyrophoric" means a chemical that will ignite spontaneously in air at a temperature of 130 deg. F (54.4 deg. C) or below.

"Responsible party" means someone who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

"Specific chemical identity" means the chemical name, Chemical Abstracts Service (CAS) Registry Number, or any other information that reveals the precise chemical designation of the substance.

"Trade secret" means any confidential formula, pattern, process, device, information or compilation of information that is used in an employer's business, and that gives the employer an opportunity to obtain an advantage over competitors who do not know or use it. Appendix D sets out the criteria to be used in evaluating trade secrets.

"Unstable (reactive)" means a chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure or temperature.

"Use" means to package, handle, react, emit, extract, generate as a byproduct, or transfer.

"Water-reactive" means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

"Work area" means a room or defined space in a workplace where hazardous chemicals are produced or used, and where employees are present.
"Workplace" means an establishment, job site, or project, at one geographical location containing one or more work areas.

1910.1200(d)

"Hazard determination."

1910.1200(d)(1)

Chemical manufacturers and importers shall evaluate chemicals produced in their workplaces or imported by them to determine if they are hazardous. Employers are not required to evaluate chemicals unless they choose not to rely on the evaluation performed by the chemical manufacturer or importer for the chemical to satisfy this requirement.

1910.1200(d)(2)

Chemical manufacturers, importers or employers evaluating chemicals shall identify and consider the available scientific evidence concerning such hazards. For health hazards, evidence which is statistically significant and which is based on at least one positive study conducted in accordance with established scientific principles is considered to be sufficient to establish a hazardous effect if the results of the study meet the definitions of health hazards in this section. Appendix A shall be consulted for the scope of health hazards covered, and Appendix B shall be consulted for the criteria to be followed with respect to the completeness of the evaluation, and the data to be reported.

1910.1200(d)(3)

The chemical manufacturer, importer or employer evaluating chemicals shall treat the following sources as establishing that the chemicals listed in them are hazardous:

1910.1200(d)(3)(i)

29 CFR part 1910, subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration (OSHA); or,

1910.1200(d)(3)(ii)

"Threshold Limit Values for Chemical Substances and Physical Agents in the Work Environment," American Conference of Governmental Industrial Hygienists (ACGIH) (latest edition). The chemical manufacturer, importer, or employer is still responsible for evaluating the hazards associated with the chemicals in these source lists in accordance with the requirements of this standard.
1910.1200(d)(4)

Chemical manufacturers, importers and employers evaluating chemicals shall treat the following sources as establishing that a chemical is a carcinogen or potential carcinogen for hazard communication purposes:

1910.1200(d)(4)(i)

National Toxicology Program (NTP), "Annual Report on Carcinogens" (latest edition);

1910.1200(d)(4)(ii)

International Agency for Research on Cancer (IARC) "Monographs" (latest editions); or

1910.1200(d)(4)(iii)

29 CFR part 1910, subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration.

Note: The "Registry of Toxic Effects of Chemical Substances" published by the National Institute for Occupational Safety and Health indicates whether a chemical has been found by NTP or IARC to be a potential carcinogen.

1910.1200(d)(5)

The chemical manufacturer, importer or employer shall determine the hazards of mixtures of chemicals as follows:

1910.1200(d)(5)(i)

If a mixture has been tested as a whole to determine its hazards, the results of such testing shall be used to determine whether the mixture is hazardous;

1910.1200(d)(5)(ii)

If a mixture has not been tested as a whole to determine whether the mixture is a health hazard, the mixture shall be assumed to present the same health hazards as do the components which comprise one percent (by weight or volume) or greater of the mixture, except that the mixture shall be assumed to present a carcinogenic hazard if it contains a component in concentrations of 0.1 percent or greater which is considered to be a carcinogen under paragraph (d)(4) of this section;

1910.1200(d)(5)(iii)

If a mixture has not been tested as a whole to determine whether the mixture is a physical hazard, the chemical manufacturer, importer, or employer may use whatever scientifically valid data is avail-
able to evaluate the physical hazard potential of the mixture; and,

1910.1200(d)(5)(iv)

If the chemical manufacturer, importer, or employer has evidence to indicate that a component present in the mixture in concentrations of less than one percent (or in the case of carcinogens, less than 0.1 percent) could be released in concentrations which would exceed an established OSHA permissible exposure limit or ACGIH Threshold Limit Value, or could present a health risk to employees in those concentrations, the mixture shall be assumed to present the same hazard.

1910.1200(d)(6)

Chemical manufacturers, importers, or employers evaluating chemicals shall describe in writing the procedures they use to determine the hazards of the chemical they evaluate. The written procedures are to be made available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director. The written description may be incorporated into the written hazard communication program required under paragraph (e) of this section.

1910.1200(e)

"Written hazard communication program."

1910.1200(e)(1)

Employers shall develop, implement, and maintain at each workplace, a written hazard communication program which at least describes how the criteria specified in paragraphs (f), (g), and (h) of this section for labels and other forms of warning, material safety data sheets, and employee information and training will be met, and which also includes the following:

1910.1200(e)(1)(i)

A list of the hazardous chemicals known to be present using an identity that is referenced on the appropriate material safety data sheet (the list may be compiled for the workplace as a whole or for individual work areas); and,

1910.1200(e)(1)(ii)

The methods the employer will use to inform employees of the hazards of non-routine tasks (for example, the cleaning of reactor vessels), and the hazards associated with chemicals contained in unlabeled pipes in their work areas.

1910.1200(e)(2)

"Multi-employer workplaces." Employers who produce, use, or store hazardous chemicals at a workplace in such a way that the employees of other employer(s) may be exposed (for example, employees of a construction contractor working on-site) shall additionally ensure that the hazard
communication programs developed and implemented under this paragraph (e) include the following:

**1910.1200(e)(2)(i)**

The methods the employer will use to provide the other employer(s) on-site access to material safety data sheets for each hazardous chemical the other employer(s)' employees may be exposed to while working;

**..1910.1200(e)(2)(ii)**

**1910.1200(e)(2)(ii)**

The methods the employer will use to inform the other employer(s) of any precautionary measures that need to be taken to protect employees during the workplace's normal operating conditions and in foreseeable emergencies; and,

**1910.1200(e)(2)(iii)**

The methods the employer will use to inform the other employer(s) of the labeling system used in the workplace.

**1910.1200(e)(3)**

The employer may rely on an existing hazard communication program to comply with these requirements, provided that it meets the criteria established in this paragraph (e).

**1910.1200(e)(4)**

The employer shall make the written hazard communication program available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director, in accordance with the requirements of 29 CFR 1910.1020 (e).

**1910.1200(e)(5)**

Where employees must travel between workplaces during a workshift, i.e., their work is carried out at more than one geographical location, the written hazard communication program may be kept at the primary workplace facility.

**1910.1200(f)**

"Labels and other forms of warning."
1910.1200(f)(1)

The chemical manufacturer, importer, or distributor shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged or marked with the following information:

..1910.1200(f)(1)(i)

1910.1200(f)(1)(i)

Identity of the hazardous chemical(s);

1910.1200(f)(1)(ii)

Appropriate hazard warnings; and

1910.1200(f)(1)(iii)

Name and address of the chemical manufacturer, importer, or other responsible party.

1910.1200(f)(2)

1910.1200(f)(2)(i)

For solid metal (such as a steel beam or a metal casting), solid wood, or plastic items that are not exempted as articles due to their downstream use, or shipments of whole grain, the required label may be transmitted to the customer at the time of the initial shipment, and need not be included with subsequent shipments to the same employer unless the information on the label changes;

1910.1200(f)(2)(ii)

The label may be transmitted with the initial shipment itself, or with the material safety data sheet that is to be provided prior to or at the time of the first shipment; and,

1910.1200(f)(2)(iii)

This exception to requiring labels on every container of hazardous chemicals is only for the solid material itself, and does not apply to hazardous chemicals used in conjunction with, or known to be present with, the material and to which employees handling the items in transit may be exposed (for example, cutting fluids or pesticides in grains).

..1910.1200(f)(3)

1910.1200(f)(3)

Chemical manufacturers, importers, or distributors shall ensure that each container of hazardous
chemicals leaving the workplace is labeled, tagged, or marked in accordance with this section in a manner which does not conflict with the requirements of the Hazardous Materials Transportation Act (49 U.S.C. 1801 et seq.) and regulations issued under that Act by the Department of Transportation.

1910.1200(f)(4)

If the hazardous chemical is regulated by OSHA in a substance-specific health standard, the chemical manufacturer, importer, distributor or employer shall ensure that the labels or other forms of warning used are in accordance with the requirements of that standard.

1910.1200(f)(5)

Except as provided in paragraphs (f)(6) and (f)(7) of this section, the employer shall ensure that each container of hazardous chemicals in the workplace is labeled, tagged or marked with the following information:

1910.1200(f)(5)(i)

Identity of the hazardous chemical(s) contained therein; and,

1910.1200(f)(5)(ii)

Appropriate hazard warnings, or alternatively, words, pictures, symbols, or combination thereof, which provide at least general information regarding the hazards of the chemicals, and which, in conjunction with the other information immediately available to employees under the hazard communication program, will provide employees with the specific information regarding the physical and health hazards of the hazardous chemical.

1910.1200(f)(6)

The employer may use signs, placards, process sheets, batch tickets, operating procedures, or other such written materials in lieu of affixing labels to individual stationary process containers, as long as the alternative method identifies the containers to which it is applicable and conveys the information required by paragraph (f)(5) of this section to be on a label. The written materials shall be readily accessible to the employees in their work area throughout each work shift.

1910.1200(f)(7)

The employer is not required to label portable containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for the immediate use of the employee who performs the transfer. For purposes of this section, drugs which are dispensed by a pharmacy to a health care provider for direct administration to a patient are exempted from labeling.
1910.1200(f)(8)

The employer shall not remove or deface existing labels on incoming containers of hazardous chemicals, unless the container is immediately marked with the required information.

1910.1200(f)(9)

The employer shall ensure that labels or other forms of warning are legible, in English, and prominently displayed on the container, or readily available in the work area throughout each work shift. Employers having employees who speak other languages may add the information in their language to the material presented, as long as the information is presented in English as well.

1910.1200(f)(10)

The chemical manufacturer, importer, distributor or employer need not affix new labels to comply with this section if existing labels already convey the required information.

1910.1200(f)(11)

Chemical manufacturers, importers, distributors, or employers who become newly aware of any significant information regarding the hazards of a chemical shall revise the labels for the chemical within three months of becoming aware of the new information. Labels on containers of hazardous chemicals shipped after that time shall contain the new information. If the chemical is not currently produced or imported, the chemical manufacturer, importers, distributor, or employer shall add the information to the label before the chemical is shipped or introduced into the workplace again.

1910.1200(g)

"Material safety data sheets."

1910.1200(g)(1)

Chemical manufacturers and importers shall obtain or develop a material safety data sheet for each hazardous chemical they produce or import. Employers shall have a material safety data sheet in the workplace for each hazardous chemical which they use.

1910.1200(g)(2)

Each material safety data sheet shall be in English (although the employer may maintain copies in other languages as well), and shall contain at least the following information:

1910.1200(g)(2)(i)

The identity used on the label, and, except as provided for in paragraph (i) of this section on trade secrets:
1910.1200(g)(2)(i)(A)

If the hazardous chemical is a single substance, its chemical and common name(s);

1910.1200(g)(2)(i)(B)

If the hazardous chemical is a mixture which has been tested as a whole to determine its hazards, the chemical and common name(s) of the ingredients which contribute to these known hazards, and the common name(s) of the mixture itself; or,

1910.1200(g)(2)(i)(C)

If the hazardous chemical is a mixture which has not been tested as a whole:

..1910.1200(g)(2)(i)(C)(1)

1910.1200(g)(2)(i)(C)(1)

The chemical and common name(s) of all ingredients which have been determined to be health hazards, and which comprise 1% or greater of the composition, except that chemicals identified as carcinogens under paragraph (d) of this section shall be listed if the concentrations are 0.1% or greater; and,

1910.1200(g)(2)(i)(C)(2)

The chemical and common name(s) of all ingredients which have been determined to be health hazards, and which comprise less than 1% (0.1% for carcinogens) of the mixture, if there is evidence that the ingredient(s) could be released from the mixture in concentrations which would exceed an established OSHA permissible exposure limit or ACGIH Threshold Limit Value, or could present a health risk to employees; and,

1910.1200(g)(2)(i)(C)(3)

The chemical and common name(s) of all ingredients which have been determined to present a physical hazard when present in the mixture;

1910.1200(g)(2)(ii)

Physical and chemical characteristics of the hazardous chemical (such as vapor pressure, flash point);

1910.1200(g)(2)(iii)

The physical hazards of the hazardous chemical, including the potential for fire, explosion, and reactivity;
1910.1200(g)(2)(iv)

The health hazards of the hazardous chemical, including signs and symptoms of exposure, and any medical conditions which are generally recognized as being aggravated by exposure to the chemical;

1910.1200(g)(2)(v)

The primary route(s) of entry;

1910.1200(g)(2)(vi)

The OSHA permissible exposure limit, ACGIH Threshold Limit Value, and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the material safety data sheet, where available;

1910.1200(g)(2)(vii)

Whether the hazardous chemical is listed in the National Toxicology Program (NTP) Annual Report on Carcinogens (latest edition) or has been found to be a potential carcinogen in the International Agency for Research on Cancer (IARC) Monographs (latest editions), or by OSHA;

1910.1200(g)(2)(viii)

Any generally applicable precautions for safe handling and use which are known to the chemical manufacturer, importer or employer preparing the material safety data sheet, including appropriate hygienic practices, protective measures during repair and maintenance of contaminated equipment, and procedures for clean-up of spills and leaks;

1910.1200(g)(2)(ix)

Any generally applicable control measures which are known to the chemical manufacturer, importer or employer preparing the material safety data sheet, such as appropriate engineering controls, work practices, or personal protective equipment;

1910.1200(g)(2)(x)

Emergency and first aid procedures;

1910.1200(g)(2)(xi)

The date of preparation of the material safety data sheet or the last change to it; and,

1910.1200(g)(2)(xii)

The name, address and telephone number of the chemical manufacturer, importer, employer or
other responsible party preparing or distributing the material safety data sheet, who can provide additional information on the hazardous chemical and appropriate emergency procedures, if necessary.

**1910.1200(g)(3)**

If no relevant information is found for any given category on the material safety data sheet, the chemical manufacturer, importer or employer preparing the material safety data sheet shall mark it to indicate that no applicable information was found.

**1910.1200(g)(4)**

Where complex mixtures have similar hazards and contents (i.e. the chemical ingredients are essentially the same, but the specific composition varies from mixture to mixture), the chemical manufacturer, importer or employer may prepare one material safety data sheet to apply to all of these similar mixtures.

**1910.1200(g)(5)**

The chemical manufacturer, importer or employer preparing the material safety data sheet shall ensure that the information recorded accurately reflects the scientific evidence used in making the hazard determination. If the chemical manufacturer, importer or employer preparing the material safety data sheet becomes newly aware of any significant information regarding the hazards of a chemical, or ways to protect against the hazards, this new information shall be added to the material safety data sheet within three months. If the chemical is not currently being produced or imported the chemical manufacturer or importer shall add the information to the material safety data sheet before the chemical is introduced into the workplace again.

**1910.1200(g)(6)**

**1910.1200(g)(6)(i)**

Chemical manufacturers or importers shall ensure that distributors and employers are provided an appropriate material safety data sheet with their initial shipment, and with the first shipment after a material safety data sheet is updated;

**1910.1200(g)(6)(ii)**

The chemical manufacturer or importer shall either provide material safety data sheets with the shipped containers or send them to the distributor or employer prior to or at the time of the ship-
If the material safety data sheet is not provided with a shipment that has been labeled as a hazardous chemical, the distributor or employer shall obtain one from the chemical manufacturer or importer as soon as possible; and,

The chemical manufacturer or importer shall also provide distributors or employers with a material safety data sheet upon request.

Distributors shall ensure that material safety data sheets, and updated information, are provided to other distributors and employers with their initial shipment and with the first shipment after a material safety data sheet is updated;

The distributor shall either provide material safety data sheets with the shipped containers, or send them to the other distributor or employer prior to or at the time of the shipment;

Retail distributors selling hazardous chemicals to employers having a commercial account shall provide a material safety data sheet to such employers upon request, and shall post a sign or otherwise inform them that a material safety data sheet is available;

Wholesale distributors selling hazardous chemicals to employers over-the-counter may also provide material safety data sheets upon the request of the employer at the time of the over-the-counter purchase, and shall post a sign or otherwise inform such employers that a material safety data sheet is available;

If an employer without a commercial account purchases a hazardous chemical from a retail distributor not required to have material safety data sheets on file (i.e., the retail distributor does not have commercial accounts and does not use the materials), the retail distributor shall provide the employer, upon request, with the name, address, and telephone number of the chemical manufacturer, importer, or distributor from which a material safety data sheet can be obtained;
1910.1200(g)(7)(vi)

Wholesale distributors shall also provide material safety data sheets to employers or other distributors upon request; and,

1910.1200(g)(7)(vii)

Chemical manufacturers, importers, and distributors need not provide material safety data sheets to retail distributors that have informed them that the retail distributor does not sell the product to commercial accounts or open the sealed container to use it in their own workplaces.

1910.1200(g)(8)

The employer shall maintain in the workplace copies of the required material safety data sheets for each hazardous chemical, and shall ensure that they are readily accessible during each work shift to employees when they are in their work area(s). (Electronic access, microfiche, and other alternatives to maintaining paper copies of the material safety data sheets are permitted as long as no barriers to immediate employee access in each workplace are created by such options.)

1910.1200(g)(9)

Where employees must travel between workplaces during a workshift, i.e., their work is carried out at more than one geographical location, the material safety data sheets may be kept at the primary workplace facility. In this situation, the employer shall ensure that employees can immediately obtain the required information in an emergency.

1910.1200(g)(10)

Material safety data sheets may be kept in any form, including operating procedures, and may be designed to cover groups of hazardous chemicals in a work area where it may be more appropriate to address the hazards of a process rather than individual hazardous chemicals. However, the employer shall ensure that in all cases the required information is provided for each hazardous chemical, and is readily accessible during each work shift to employees when they are in their work area(s).

1910.1200(g)(11)

Material safety data sheets shall also be made readily available, upon request, to designated representatives and to the Assistant Secretary, in accordance with the requirements of 29 CFR 1910.1020(e). The Director shall also be given access to material safety data sheets in the same manner.

1910.1200(h)
1910.1200(h)

"Employee information and training."

1910.1200(h)(1)

Employers shall provide employees with effective information and training on hazardous chemicals in their work area at the time of their initial assignment, and whenever a new physical or health hazard the employees have not previously been trained about is introduced into their work area. Information and training may be designed to cover categories of hazards (e.g., flammability, carcinogenicity) or specific chemicals. Chemical-specific information must always be available through labels and material safety data sheets.

1910.1200(h)(2)

"Information." Employees shall be informed of:

1910.1200(h)(2)(i)

The requirements of this section;

1910.1200(h)(2)(ii)

Any operations in their work area where hazardous chemicals are present; and,

1910.1200(h)(2)(iii)

The location and availability of the written hazard communication program, including the required list(s) of hazardous chemicals, and material safety data sheets required by this section.

1910.1200(h)(3)

"Training." Employee training shall include at least:

1910.1200(h)(3)(i)

Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

1910.1200(h)(3)(ii)

The physical and health hazards of the chemicals in the work area;

1910.1200(h)(3)(iii)

The measures employees can take to protect themselves from these hazards, including specific pro-
cedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and,

**1910.1200(h)(3)(iv)**

The details of the hazard communication program developed by the employer, including an explanation of the labeling system and the material safety data sheet, and how employees can obtain and use the appropriate hazard information.

**1910.1200(i)**

"Trade secrets."

**1910.1200(i)(1)**

The chemical manufacturer, importer, or employer may withhold the specific chemical identity, including the chemical name and other specific identification of a hazardous chemical, from the material safety data sheet, provided that:

**1910.1200(i)(1)(i)**

The claim that the information withheld is a trade secret can be supported;

**1910.1200(i)(1)(ii)**

Information contained in the material safety data sheet concerning the properties and effects of the hazardous chemical is disclosed;

**1910.1200(i)(1)(iii)**

The material safety data sheet indicates that the specific chemical identity is being withheld as a trade secret; and,

**1910.1200(i)(1)(iv)**

The specific chemical identity is made available to health professionals, employees, and designated representatives in accordance with the applicable provisions of this paragraph.

**1910.1200(i)(2)**

Where a treating physician or nurse determines that a medical emergency exists and the specific chemical identity of a hazardous chemical is necessary for emergency or first-aid treatment, the chemical manufacturer, importer, or employer shall immediately disclose the specific chemical identity of a trade secret chemical to that treating physician or nurse, regardless of the existence of a written statement of need or a confidentiality agreement. The chemical manufacturer, importer,
or employer may require a written statement of need and confidentiality agreement, in accordance with the provisions of paragraphs (i)(3) and (4) of this section, as soon as circumstances permit.

1910.1200(i)(3)

In non-emergency situations, a chemical manufacturer, importer, or employer shall, upon request, disclose a specific chemical identity, otherwise permitted to be withheld under paragraph (i)(1) of this section, to a health professional (i.e. physician, industrial hygienist, toxicologist, epidemiologist, or occupational health nurse) providing medical or other occupational health services to exposed employee(s), and to employees or designated representatives, if:

1910.1200(i)(3)(i)
The request is in writing;

1910.1200(i)(3)(ii)
The request describes with reasonable detail one or more of the following occupational health needs for the information:

1910.1200(i)(3)(ii)(A)
To assess the hazards of the chemicals to which employees will be exposed;

1910.1200(i)(3)(ii)(B)
To conduct or assess sampling of the workplace atmosphere to determine employee exposure levels;

1910.1200(i)(3)(ii)(C)
To conduct pre-assignment or periodic medical surveillance of exposed employees;

1910.1200(i)(3)(ii)(D)
To provide medical treatment to exposed employees;

1910.1200(i)(3)(ii)(E)
To select or assess appropriate personal protective equipment for exposed employees;

1910.1200(i)(3)(ii)(F)
To design or assess engineering controls or other protective measures for exposed employees; and,

1910.1200(i)(3)(ii)(G)
To conduct studies to determine the health effects of exposure.
1910.1200(i)(3)(iii)

The request explains in detail why the disclosure of the specific chemical identity is essential and that, in lieu thereof, the disclosure of the following information to the health professional, employee, or designated representative, would not satisfy the purposes described in paragraph (i)(3)(ii) of this section:

1910.1200(i)(3)(iii)(A)

The properties and effects of the chemical;

1910.1200(i)(3)(iii)(B)

Measures for controlling workers' exposure to the chemical;

1910.1200(i)(3)(iii)(C)

Methods of monitoring and analyzing worker exposure to the chemical; and,

1910.1200(i)(3)(iii)(D)

Methods of diagnosing and treating harmful exposures to the chemical;

1910.1200(i)(3)(iv)

The request includes a description of the procedures to be used to maintain the confidentiality of the disclosed information; and,

1910.1200(i)(3)(v)

The health professional, and the employer or contractor of the services of the health professional (i.e. downstream employer, labor organization, or individual employee), employee, or designated representative, agree in a written confidentiality agreement that the health professional, employee, or designated representative, will not use the trade secret information for any purpose other than the health need(s) asserted and agree not to release the information under any circumstances other than to OSHA, as provided in paragraph (i)(6) of this section, except as authorized by the terms of the agreement or by the chemical manufacturer, importer, or employer.

1910.1200(i)(4)

The confidentiality agreement authorized by paragraph (i)(3)(iv) of this section:

1910.1200(i)(4)(i)

May restrict the use of the information to the health purposes indicated in the written statement of need;
1910.1200(i)(4)(ii)
May provide for appropriate legal remedies in the event of a breach of the agreement, including stipulation of a reasonable pre-estimate of likely damages; and,

1910.1200(i)(4)(iii)
May not include requirements for the posting of a penalty bond.

1910.1200(i)(5)
Nothing in this standard is meant to preclude the parties from pursuing non-contractual remedies to the extent permitted by law.

1910.1200(i)(6)
If the health professional, employee, or designated representative receiving the trade secret information decides that there is a need to disclose it to OSHA, the chemical manufacturer, importer, or employer who provided the information shall be informed by the health professional, employee, or designated representative prior to, or at the same time as, such disclosure.

..1910.1200(i)(7)

1910.1200(i)(7)
If the chemical manufacturer, importer, or employer denies a written request for disclosure of a specific chemical identity, the denial must:

1910.1200(i)(7)(i)
Be provided to the health professional, employee, or designated representative, within thirty days of the request;

1910.1200(i)(7)(ii)
Be in writing;

1910.1200(i)(7)(iii)
Include evidence to support the claim that the specific chemical identity is a trade secret;

1910.1200(i)(7)(iv)
State the specific reasons why the request is being denied; and,

1910.1200(i)(7)(v)
Explain in detail how alternative information may satisfy the specific medical or occupational health need without revealing the specific chemical identity.
1910.1200(i)(8)

The health professional, employee, or designated representative whose request for information is denied under paragraph (i)(3) of this section may refer the request and the written denial of the request to OSHA for consideration.

1910.1200(i)(9)

When a health professional, employee, or designated representative refers the denial to OSHA under paragraph (i)(8) of this section, OSHA shall consider the evidence to determine if:

..1910.1200(i)(9)(i)

1910.1200(i)(9)(i)

The chemical manufacturer, importer, or employer has supported the claim that the specific chemical identity is a trade secret;

1910.1200(i)(9)(ii)

The health professional, employee, or designated representative has supported the claim that there is a medical or occupational health need for the information; and,

1910.1200(i)(9)(iii)

The health professional, employee or designated representative has demonstrated adequate means to protect the confidentiality.

1910.1200(i)(10)

1910.1200(i)(10)(i)

If OSHA determines that the specific chemical identity requested under paragraph (i)(3) of this section is not a "bona fide" trade secret, or that it is a trade secret, but the requesting health professional, employee, or designated representative has a legitimate medical or occupational health need for the information, has executed a written confidentiality agreement, and has shown adequate means to protect the confidentiality of the information, the chemical manufacturer, importer, or employer will be subject to citation by OSHA.

..1910.1200(i)(10)(ii)

1910.1200(i)(10)(ii)

If a chemical manufacturer, importer, or employer demonstrates to OSHA that the execution of a confidentiality agreement would not provide sufficient protection against the potential harm from the unauthorized disclosure of a trade secret specific chemical identity, the Assistant Secretary may issue such orders or impose such additional limitations or conditions upon the disclosure of the requested chemical information as may be appropriate to assure that the occupational health services
are provided without an undue risk of harm to the chemical manufacturer, importer, or employer.

1910.1200(i)(11)

If a citation for a failure to release specific chemical identity information is contested by the chemical manufacturer, importer, or employer, the matter will be adjudicated before the Occupational Safety and Health Review Commission in accordance with the Act’s enforcement scheme and the applicable Commission rules of procedure. In accordance with the Commission rules, when a chemical manufacturer, importer, or employer continues to withhold the information during the contest, the Administrative Law Judge may review the citation and supporting documentation "in camera" or issue appropriate orders to protect the confidentiality of such matters.

1910.1200(i)(12)

Notwithstanding the existence of a trade secret claim, a chemical manufacturer, importer, or employer shall, upon request, disclose to the Assistant Secretary any information which this section requires the chemical manufacturer, importer, or employer to make available. Where there is a trade secret claim, such claim shall be made no later than at the time the information is provided to the Assistant Secretary so that suitable determinations of trade secret status can be made and the necessary protections can be implemented.

1910.1200(i)(13)

Nothing in this paragraph shall be construed as requiring the disclosure under any circumstances of process or percentage of mixture information which is a trade secret.

..1910.1200(j)

1910.1200(j)

"Effective dates." Chemical manufacturers, importers, distributors, and employers shall be in compliance with all provisions of this section by March 11, 1994.

Note: The effective date of the clarification that the exemption of wood and wood products from the Hazard Communication standard in paragraph (b)(6)(iv) only applies to wood and wood products including lumber which will not be processed, where the manufacturer or importer can establish that the only hazard they pose to employees is the potential for flammability or combustibility, and that the exemption does not apply to wood or wood products which have been treated with a hazardous chemical covered by this standard, and wood which may be subsequently sawed or cut generating dust has been stayed from March 11, 1994 to August 11, 1994.

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