

Night Shift Health and Safety Workbook

First
Edition

Written and Produced by



The Rutgers Occupational Training and Education Consortium (OTEC)
and New Labor



For the University of Medicine & Dentistry of New Jersey (UMDNJ),
School of Public Health, Office of Public Health Practice



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About This Book

Funding for this workbook was provided through a one year training grant from the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA), Susan Harwood Grants program.

OTEC/LOSHI

Occupational Training and Education Consortium (OTEC)

OTEC partners with unions, employers and other organizations to develop innovative training programs that work toward strengthening the existing systems of safety in the workplace. Relying on participatory educational models, OTEC is committed to building a lasting “culture of safety” in workplaces in New Jersey and around the country.

Latino Occupational Safety and Health Initiative (LOSHI)

LOSHI was established by OTEC and New Labor. Through partnerships with employers, staffing firms, unions and community and faith based organizations LOSHI has developed a series of comprehensive site-specific safety and health training programs, trained over 100 worker-trainers and delivered thousands of hours of training to Latino workers throughout New Jersey.

Programs and Services

For more information about OTEC’s programs and services, contact:

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New Labor

New Labor is an alternative model of worker organization that combines new and existing strategies to improve working conditions and provide a voice for immigrant workers in central New Jersey. Adapting to changes in the economy, New Labor strategically utilizes worker advocacy, customized training, and grassroots enterprises to leverage members' interests at work and in their communities. Since its founding in January of 2000, New Labor has grown to over 1,400 dues paying members and provides important solutions to the challenges faced by low-wage workers in today's economy.

Visit New Labor's website at www.newlabor.net

For more information about New Labor contact:

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The Small Group Activity Method

Basic Structure

The Small Group Activity Method is based on activities. An activity can take from 45 minutes to an hour. Each Activity has a common basic structure:

- **Small Group Tasks**
- **Report-Back**
- **Summary**

1. Small Group Tasks: Activities include tasks (problems), or sets of tasks, for the groups to work on. Each task asks that groups use their experience and the factsheets to solve problems and make judgements on key issues.

2. Report-Back: For each task, groups select scribes that take notes on the small group discussions and report back to the class as a whole. During the report-back the scribe informs the entire class as to how his or her group solved the particular problem. The trainer records each scribes report-back on large pads of paper in front of the class so that everyone can refer to them.

3. Summary: Before the discussion drifts too far, the trainer needs to bring it all together during the summary. Here, the trainer highlights the key points of the Activity and brings up any problems or points that may have been overlooked during the report-back.

Three Basic Learning Exchanges

The Small Group Activity Method is based on the idea that every training is a place where learning is shared. With SGAM, learning is not a one-way street that runs from trainer to worker. Rather SGAM is a structured procedure that allows us to share information. It is based on three learning exchanges:

- **Worker-to-Worker**
- **Worker-to-Trainer**
- **Trainer-to-Worker**

Worker-to-Worker: Most of us learn best from each other. SGAM is structured so that the worker-to-worker exchange is a key element of the training. The worker-to-worker exchange allows participants to learn from each other by solving problems in their small groups.

Worker-to-Trainer: Lecture-style training assumes that the trainer knows all the answers. With SGAM it is understood that the trainers also have a lot to learn and this is the purpose of the worker-to-trainer exchange. It occurs during the report-back and it is designed to give the trainer an opportunity to learn from the participants.

Trainer-to-Worker: This is the trainer's opportunity to clear up confusion and make points they think are key. By waiting until the summary section, trainers know better what people need to know.

Activity 1: Chemical Hazards and MSDSs

Purpose

To increase our knowledge of the how we may be exposed to hazardous chemicals on the job and what we can do to reduce the risks.

This activity has two tasks.

Task 1

In your groups, read the factsheets on pages 4-11. Then based on the factsheets and your own experience write a response to the statement below. For each paragraph, list the factsheets that helped you write your response.

Statement:

“My current job involves light duty maintenance and janitorial work. Most of the time I clean floors and rugs so I don’t have to worry about being exposed to hazardous chemicals.

For many years I worked at a place that produced hazardous chemicals and I always knew when we were making the highly toxic stuff because you could smell it.

But even when I worked with highly toxic chemicals I wasn’t that concerned. The truth is as long as you don’t drink the stuff or pour it directly into your eyes, it can’t get into your system.

I should know, I was exposed a few times but nothing ever happened to me. As long as you can avoid getting a heavy dose in your system, small amounts of the stuff won’t hurt you.

I think the whole chemical hazards thing is overblown and I’m not going to worry about the cleaning chemicals I use on my job.”

How would you respond? (Please make a list.)

1.

2.

3.

4.

5.

1. Cleaning Products Can Make You Sick

Many traditional cleaning products, floor strippers and disinfectants are a source for human health and environmental problems. Cleaning products may contain chemicals that cause cancer, reproductive disorders, respiratory ailments (including occupational asthma), eye and skin irritation, central nervous system impairment and other human health effects. The wide use of cleaning products may also contribute to poor indoor air quality.

Disinfectants

Disinfectants such as quaternary ammonium compounds (quats), phenols, and bleach are registered with the Environmental Protection Agency (EPA) as pesticides. These toxic chemicals are used for routine cleaning. Health effects from long-term exposure to quats include occupational asthma and hypersensitivity syndrome.

Floor Strippers

Floor strippers contain chemicals that can seriously harm you. Workers, exposed to floor stripping and floor polishing chemicals experience headaches, eye irritation, dizziness, nausea, difficulty concentrating, fatigue, wheezing, coughing, asthma attacks, respiratory infections, hypersensitivity pneumonitis (an inflammation of the lung) and nose, throat and skin irritation. If exposure continues, irreversible lung damage and the formation of fibrous tissue (fibrosis) may occur making breathing more difficult.

Scented Cleaning Chemicals

Workers exposed to fragrance products may experience some combination of eye, nose and/or throat irritation; respiratory difficulty; possibly broncho-constriction, or asthma-like reactions; and central nervous system reactions (e.g., dizziness, incoordination, confusion, fatigue).

Ventilation and Equipment

Exposures can also occur as a result of inadequate ventilation, the incorrect mixing of chemicals and/or the utilization of spray bottles, aerosol cans, and mechanized equipment. For example, floor burnishers, buffers, and carpet washers increase the airborne concentrations of cleaning chemicals as particulate matter and become aerosolized and suspended in the air.

Cleaning Products and Occupational Asthma

Cleaning products have also been linked to high rates of occupational asthma. In fact, the rate of occupational asthma among janitorial workers is double the rate of other workers. In California, Massachusetts, Michigan, and New Jersey 12 percent of work-related asthma cases have been associated with exposure to cleaning products. Additional research has found that even short-term exposure to cleaning agents caused asthmatic attacks (Reactive Airway Dysfunction Syndrome—RADS).

Report Cases of Work-Related Asthma

Work-related asthma cases are reportable diseases in the state of NJ. In fact, New Jersey law requires that physicians and advanced practice nurses report individuals diagnosed with work-related asthma. If you think you might have work-related asthma, or would like more information, you should contact the New Jersey Department of Health and Senior Services (NJDHSS) at 609-984-1863, or go to the NJ Department of Health Work-Related Asthma website at: <http://www.state.nj.us/health/eoh/survweb/wra/index.shtml>.

Sources: *Going Green: A Resource Kit for Pollution Prevention in Health Care*, Cleaning Chemical Use in Hospitals Fact Sheet, Health Care Without Harm, www.noharm.org. *Cleaning for Health, Products and Practices for a Safer Environment*, INFORM, August 2002, www.informinc.org/cleanforhealth.php. *Pesticides, Fragrances & Cleaners*, Health Care Without Harm, www.noharm.org/us/pesticidesCleaner/CleanersDIIs.

2. Chemical Hazard Awareness

There are four basic ways that chemicals can enter your body:

- **Direct contact**—on the skin or eyes
- **Absorption**—through the skin
- **Accidental Ingestion**—through the mouth
- **Inhalation**—through the lungs

Direct Contact = Surface

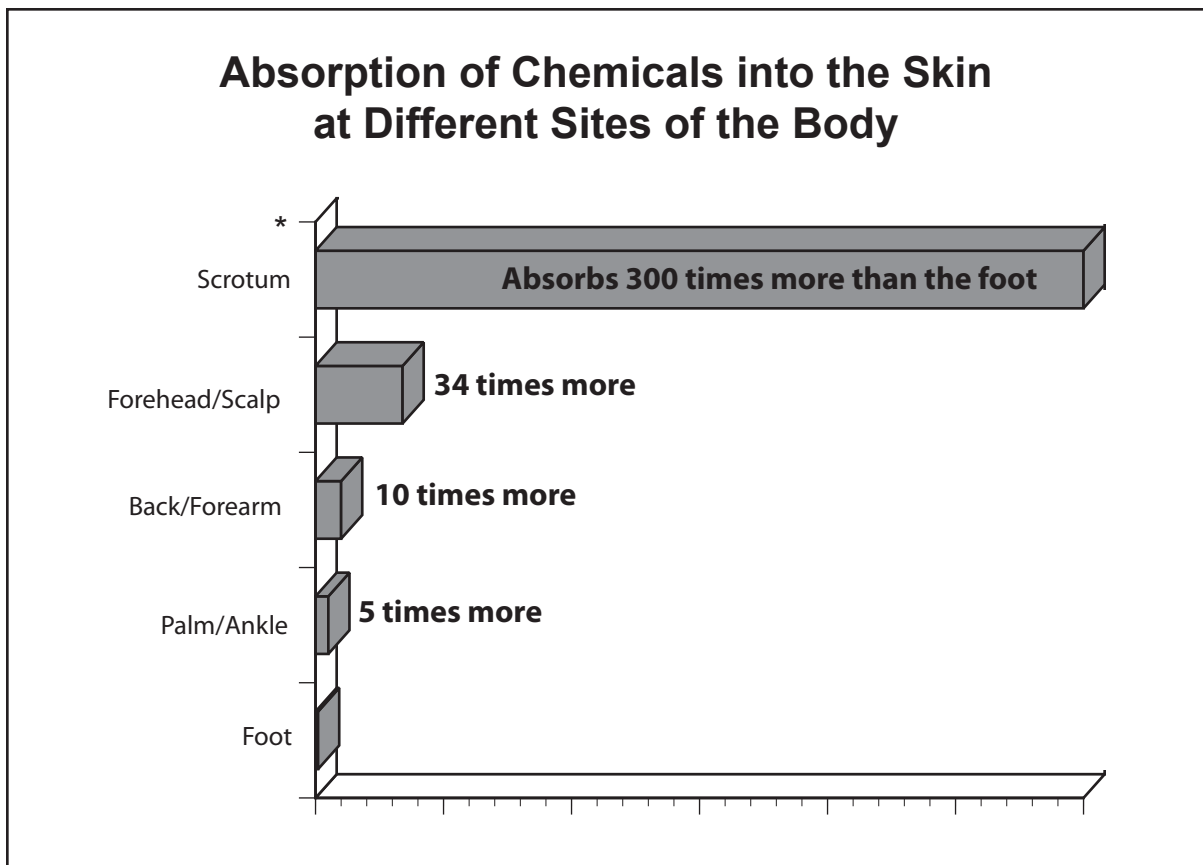
The cleaners and disinfectants we work with can burn or irritate the skin and eyes on contact, causing damage on the surface. Dermatitis (inflammation of the skin) and conjunctivitis (inflammation of the eye membrane) are two examples.

Absorption = Penetration

Some chemicals can pass right through the skin undetected and enter the bloodstream. They are carried throughout the body, causing harm. Broken skin or puncture wounds greatly increase the rate at which chemicals are absorbed.

Absorption of Chemicals by Your Body

Chemicals can enter your system by being absorbed through the skin. In fact, as the chart below shows, when it comes to absorption through the skin, different parts of your body absorb chemicals at very different rates. (If you are working with chemicals you should wash your hands **BEFORE** and after using the bathroom!)



*For men (studies of female workers yet to be done).

Source: E. Hodgson and P.E. Levi, *A Textbook of Modern Toxicology*, Second Edition. Stamford: Appleton & Lange, 1997, pg. 36-40.

3. Don't Trust Your Nose

You can't rely on your sense of smell to protect you from exposure to toxic chemicals. Let's face it, your nose has some important limitations. Here are the basic ones:

- Some dangerous chemicals, such as carbon monoxide, are odorless. No nose can smell them.
- For some chemicals, you can only detect the smell when the toxin is around you in such large quantities that your health is being harmed by it. For example, by the time you can smell ethylene oxide (used in gas sterilizers), you're already in trouble.
- Our noses can become accustomed to chemicals. That means that after a while we can't smell even very powerful odors. For instance, our noses can learn to turn off strong odors like ammonia and bleach.

4. Dose and the Body's Response

After ingestion, inhalation or skin contact, toxic chemicals as well as their by-products react in the body. For most toxic substances to cause harm there needs to be a sufficient "dose" given.

"Dose" refers to how much a substance reacts with the body. Dose is measured by the concentration of the substance and the time period of the exposure.

The higher the concentration, the larger the dose.

The longer the exposure, the larger the dose.

There are basically two ways the body reacts to a dose of a toxic substance:

- **Linear/Non-Threshold** For any dose, no matter how small, the body may have a reaction. This type of response may be found with cancer-causing chemicals and cancer-causing physical agents, such as radiation. **Any** dose carries a risk.
- **Threshold** There needs to be a certain level of dose before there is a bodily response. This type of response is found with most toxic chemicals (not for cancer-causing agents and chemicals). For example, low-level exposure to methanol throughout the plant is not very harmful, but at higher concentrations it will cause irritation to the eyes, mucous membranes, and upper respiratory tract. Nausea, dizziness and headaches may result.

Sources: *Centers for Disease Control, 1998*. OSHA, May 1995; *Fit the Glove* by Gerard Arotti. Michael Roder, *A Guide For Evaluating the Performance of Chemical Protective Clothing (CPC)*, US Dept. of Health and Human Services; June 1990.

5. The Long and Short of It

There are two different types of effects that result from toxic exposure. They are acute and chronic.

Acute Effects

“Acute” means that health effects are felt at the time of exposure or shortly after, or result from a short-term, highly concentrated exposure. Examples of acute effects:

- Hydrogen chloride (HCl), when inhaled, causes fluid to collect in the lungs (pulmonary edema) and bleeding in the respiratory tract. When it comes into contact with the skin, it causes severe burns unless promptly washed off.
- Caustic soda, also known as sodium hydroxide (NaOH), corrodes the skin. It burns, and actually dissolves the skin while in contact with it.
- Carbon monoxide (CO) bonds to the protein in blood that is responsible for carrying oxygen to the cells. If enough of the blood bonds with CO instead of oxygen, the cells “starve” and you may die.

Although acute toxicity is often seen within minutes or hours after a sudden, high exposure there are some instances where a one-time high-level exposure causes delayed effects. For example, symptoms of high exposures to certain pesticides may not appear for several days.

Chronic Effects

“Chronic” is a word that means the ill effects will not be seen for some time after exposure. It is associated with low concentration exposures over a longer period of time.

- Cancer is a chronic effect, as is asbestosis.
- Lung diseases, like bronchitis and emphysema, are examples of noncancerous, chronic diseases.
- Solvents can cause chronic damage to the liver, kidneys and brain.

Many chemicals can cause either chronic or acute effects. The difference is in the amount of the dose. High doses generally cause acute effects. Low doses over time cause chronic effects.

- Exposure to PCBs in large doses can cause a skin disease called chloracne.
- Exposure to benzene over a long period of time can cause leukemia, a chronic effect.
- Exposure to arsenic over a long period of time can cause lung cancer, a chronic effect.

Task 2

In your groups review the factsheets (including the MSDS for sodium hypochlorite solution) on pages 14-29. Then based on your own experience and the factsheets answer the questions below.

1. If you worked with sodium hypochlorite solution would you be concerned about a fire or explosion hazard?

 Yes
 No

2. What personal protective equipment (PPE) does the MSDS call for in handling sodium hypochlorite solution?

3. What first aid is recommended for sodium hypochlorite solution?

4. What is recommended for the proper storage of sodium hypochlorite solution?

5. Is sodium hypochlorite solution incompatible with other chemicals?


6. What are the health hazards that could result from exposure to sodium hypochlorite solution?

Acute (Short-Term) Hazards

Chronic (Long-Term) Hazards

7. Did you find working with the MSDS difficult or confusing?
Why or why not?

8. Are MSDSs a useful health and safety resource tool at work?
Why or why not?

MSDS Material Safety Data Sheet	24 Hour Emergency Telephone: 800-859-2151 CHEMTREC: 1-800-424-9300
	National Response in Canada CANUTEC: 613-958-4666
From: Mallinckrodt Baker, Inc. 222 Red School Lane Phillipsburg, NJ 08865	Outside U.S. and Canada Chemtrec: 703-527-3887
	NOTE: CHEMTREC, CANUTEC and National Response Center emergency numbers to be used only in the event of chemical emergencies involving a spill, leak, fire, exposure or accident involving chemicals.

All non-emergency questions should be directed to Customer Service (1-800-582-2537) for assistance.

SODIUM HYPOCHLORITE SOLUTION

MSDS Number: S4106 --- Effective Date: 05/05/00

1. Product Identification

Synonyms: Bleach; hypochlorous acid, sodium salt; soda bleach; sodium oxychloride
 CAS No.: 7681-52-9
 Molecular Weight: 74.44
 Chemical Formula: NaOCl
 Product Codes: 9416, P005

2. Composition/Information on Ingredients

Ingredient	CAS No	Percent	Hazardous
Sodium Hypochlorite (as NaOCl)	7681-52-9	5%	Yes
Water	7732-18-5	95%	No

3. Hazards Identification

Emergency Overview

WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. CAUSES SUBSTANTIAL BUT TEMPORARY EYE INJURY.

J.T. Baker SAF-T-DATA^(tm) Ratings (Provided here for your convenience)

Health Rating: 2 - Moderate
 Flammability Rating: 0 - None
 Reactivity Rating: 1 - Slight
 Contact Rating: 2 - Moderate
 Lab Protective Equip: GOGGLES; LAB COAT
 Storage Color Code: Orange (General Storage)

Potential Health Effects

Inhalation:

May cause irritation to the respiratory tract, (nose and throat); symptoms may include coughing and sore throat.

Ingestion:

May cause nausea, vomiting.

Skin Contact:

May irritate skin.

Eye Contact:

Contact may cause severe irritation and damage, especially at higher concentration.

Chronic Exposure:

A constant irritant to the eyes and throat. Low potential for sensitization after exaggerated exposure to damaged skin.

Aggravation of Pre-existing Conditions:

Persons with impaired respiratory function, or heart disorders (or disease) may be more susceptible to the effects of the substance.

4. First Aid Measures

Inhalation:

Remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. Get medical attention immediately.

Ingestion:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. Get medical attention immediately.

Skin Contact:

Immediately flush skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Get medical attention immediately. Wash clothing before reuse. Thoroughly clean shoes before reuse.

Eye Contact:

Immediately flush eyes with plenty of water for at least 15 minutes, lifting lower and upper eyelids occasionally. Get medical attention immediately.

Note to Physician:

Consider oral administration of sodium thiosulfate solutions if sodium hypochlorite is ingested. Do not administer neutralizing substances since the resultant exothermic reaction could further damage tissue. Endotracheal intubation could be needed if glottic edema compromises the airway. For individuals with significant inhalation exposure, monitor arterial blood gases and chest x-ray.

5. Fire Fighting Measures

Fire:

Not considered to be a fire hazard. Substance releases oxygen when heated, which may increase the severity of an existing fire. Containers may rupture from pressure build-up.

Explosion:

This solution is not considered to be an explosion hazard. Anhydrous sodium hypochlorite is very explosive.

Fire Extinguishing Media:

Use any means suitable for extinguishing surrounding fire. Use water spray to cool fire-exposed containers, to dilute liquid, and control vapor.

Special Information:

In the event of a fire, wear full protective clothing and NIOSH-approved self-contained breathing apparatus with full facepiece operated in the pressure demand or other positive pressure mode.

6. Accidental Release Measures

Ventilate area of leak or spill. Wear appropriate personal protective equipment as specified in Section 8. Isolate hazard area. Keep unnecessary and unprotected personnel from entering. Contain and recover liquid when possible. Collect liquid in an appropriate container or absorb with an inert material (e. g., vermiculite, dry sand, earth), and place in a chemical waste container. Do not use combustible materials, such as saw dust. Do not flush to sewer! US Regulations (CERCLA) require reporting spills and releases to soil, water and air in excess of reportable quantities. The toll free number for the US Coast Guard National Response Center is (800) 424-8802.

7. Handling and Storage

Keep in a tightly closed container, stored in a cool, dry, ventilated area. Protect against physical damage. Isolate from incompatible substances. Containers of this material may be hazardous when empty since they retain product residues (vapors, liquid); observe all warnings and precautions listed for the product.

8. Exposure Controls/Personal Protection

Airborne Exposure Limits:

Sodium Hypochlorite:

AIHA (WEEL) - STEL - 2 mg/m³

-OSHA Permissible Exposure Limit (PEL):

0.5 ppm (TWA), 1 ppm (STEL) as Chlorine

-ACGIH Threshold Limit Value (TLV):

1 ppm (TWA), 3 ppm (STEL) as Chlorine

Ventilation System:

A system of local and/or general exhaust is recommended to keep employee exposures below the Airborne Exposure Limits. Local exhaust ventilation is generally preferred because it can control the emissions of the contaminant at its source, preventing dispersion of it into the general work area. Please refer to the ACGIH document, *Industrial Ventilation, A Manual of Recommended Practices*, most recent edition, for details.

Personal Respirators (NIOSH Approved):

If the exposure limit is exceeded, a full facepiece respirator with an acid gas cartridge may be worn up to 50 times the exposure limit or the maximum use concentration specified by the appropriate regulatory agency or respirator supplier, whichever is lowest. For emergencies or instances where the exposure levels are not known, use a full-facepiece positive-pressure, air-supplied respirator. **WARNING:** Air purifying respirators do not protect workers in oxygen-deficient atmospheres.

Skin Protection:

Wear impervious protective clothing, including boots, gloves, lab coat, apron or coveralls, as appropriate, to prevent skin contact.

Eye Protection:

Use chemical safety goggles and/or a full face shield where splashing is possible. Maintain eye wash fountain and quick-drench facilities in work area.

9. Physical and Chemical Properties

Appearance:
Colorless to yellowish liquid.
Odor:
Chlorine-like odor.
Solubility:
100% in water.
Density:
1.07 - 1.14
pH:
9 - 10 (neutral solution-no excess sodium hydroxide)
% Volatiles by volume @ 21C (70F):
ca. 95
Boiling Point:
40C (104F) Decomposes slightly
Melting Point:
-6C (21F)
Vapor Density (Air=1):
No information found.
Vapor Pressure (mm Hg):
17.5 @ 20C (68F)
Evaporation Rate (BuAc=1):
No information found.

10. Stability and Reactivity

Stability:
Slowly decomposes on contact with air. Rate increases with the concentration and temperature. Exposure to sunlight accelerates decomposition. Sodium hypochlorite becomes less toxic with age.
Hazardous Decomposition Products:
Emits toxic fumes of chlorine when heated to decomposition. Sodium oxide at high temperatures.
Hazardous Polymerization:
Will not occur.
Incompatibilities:
Ammonia (chloramine gas may evolve), amines, ammonium salts, aziridine, methanol, phenyl acetonitrile, cellulose, ethyleneimine, oxidizable metals, acids, soaps, and bisulfates.
Conditions to Avoid:
Light, heat, incompatibles.

11. Toxicological Information

No LD50/LC50 information found relating to normal routes of occupational exposure. Investigated as a tumorigen and mutagen. Irritation data: eye, rabbit, 10 mg - Moderate

Ingredient	---NTP Carcinogen---		IARC Category
	Known	Anticipated	
Sodium Hypochlorite (as NaOCl) (7681-52-9)	No	No	3
Water (7732-18-5)	No	No	None

12. Ecological Information

Environmental Fate:
No information found.
Environmental Toxicity:
No information found.

13. Disposal Considerations

Dilute with water and flush to sewer if local ordinances allow, otherwise, whatever cannot be saved for recovery or recycling should be managed in an appropriate and approved waste disposal facility. Processing, use or contamination of this product may change the waste management options. State and local disposal regulations may differ from federal disposal regulations. Dispose of container and unused contents in accordance with federal, state and local requirements.

14. Transport Information

Not regulated.

15. Regulatory Information

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-----\Chemical Inventory Status - Part 1\-----
Ingredient                TSCA  EC   Japan  Australia
-----
Sodium Hypochlorite (as NaOCl) (7681-52-9)  Yes  Yes  Yes    Yes
Water (7732-18-5)                          Yes  Yes  Yes    Yes
-----\Chemical Inventory Status - Part 2\-----
Ingredient                Korea  DSL   NDSL   Phil.
-----
Sodium Hypochlorite (as NaOCl) (7681-52-9)  Yes   Yes   No     Yes
Water (7732-18-5)                          Yes   Yes   No     Yes
-----\Federal, State & International Regulations - Part 1\-----
Ingredient                -SARA 302-  -SARA 313-
RQ   TPQ   List  Chemical Catg.
-----
Sodium Hypochlorite (as NaOCl) (7681-52-9) No   No    No     No
Water (7732-18-5)                          No   No    No     No
-----\Federal, State & International Regulations - Part 2\-----
Ingredient                CERCLA  -RCRA-
                261.33  8 (d)
-----
Sodium Hypochlorite (as NaOCl)
(7681-52-9)                100    No    No
Water (7732-18-5)          No     No    No
Chemical Weapons Convention: No   TSCA 12(b): No   CDTA: No
SARA 311/312: Acute: Yes   Chronic: No   Fire: No   Pressure: No
Reactivity: No                (Mixture / Liquid)

```

Australian Hazchem Code: No information found.

Poison Schedule: S5

WHMIS:

This MSDS has been prepared according to the hazard criteria of the Controlled Products Regulations (CPR) and the MSDS contains all of the information required by the CPR.

16. Other Information

NFPA Ratings: Health: 2 Flammability: 0 Reactivity: 1

Label Hazard Warning:

WARNING! HARMFUL IF SWALLOWED OR INHALED. CAUSES IRRITATION TO EYES AND RESPIRATORY TRACT. CAUSES SUBSTANTIAL BUT TEMPORARY EYE INJURY.

Label Precautions:

Avoid contact with eyes, skin and clothing.

Avoid breathing mist.

Keep container closed.

Use with adequate ventilation.

Wash thoroughly after handling.

Label First Aid:

If swallowed, DO NOT INDUCE VOMITING. Give large quantities of water. Never give anything by mouth to an unconscious person. If inhaled, remove to fresh air. If not breathing, give artificial respiration. If breathing is difficult, give oxygen. In case of contact, immediately flush eyes or skin with plenty of water for at least 15 minutes while removing contaminated clothing and shoes. Wash clothing before reuse. In all cases get medical attention immediately.

Product Use:

Laboratory Reagent.

Revision Information:

MSDS Section(s) changed since last revision of document include: 1, 2, 3, 8, 11, 14, 15, 16.

Disclaimer:

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Prepared by: Environmental Health & Safety

Phone Number: (314) 654-1600 (U.S.A.)

6. What's in an MSDS?

Material Safety Data Sheets (MSDSs) give detailed information on chemical and physical dangers, safety procedures and emergency response techniques. Employers are required to have MSDSs for every hazardous chemical in the workplace. The MSDSs must be readily accessible to all employees on every shift and in the employee's work area.

MSDSs include the following information:

1. Product identity
2. Hazardous ingredients
3. Physical and chemical characteristics
4. Fire and Explosion Data
5. Reactivity
6. Health hazards
7. Precautions for safe handling and use
8. Control measures

A description of each section is included below and on the next few pages.

Section I: Product Identity

This information gives you the product's name as it appears on the label and on the company's chemical inventory list. Product identity is usually the chemical's brand name, e.g. "Solvent 460" or "Trichlor." The manufacturer is listed along with a contact person you can call to get more information on the product.

Section II: Hazardous Ingredients

This section is the key part of the MSDS. It gives you the basic ingredients in the product and tells you the legal and recommended limits for workplace exposures. Remember to get the exact spelling of the chemicals because many chemicals have similar names but different health effects.

The following explains some technical language you might find on data sheets related to exposure limits:

PEL (Permissible Exposure Limit): This is the **maximum** exposure established by OSHA. It can be a time-weighted average (TWA) exposure limit, a “ceiling” exposure limit, or a “peak” exposure limit. These are all legal standards.

TLV (Threshold Limit Value): This is a **recommended** average concentration over an 8-hour day. This term is used to express the airborne concentration of a material to which nearly all persons supposedly can be exposed without adverse effects, day after day. TLVs can be expressed in three different ways. (TLVs are suggested, **not legal**, standards established by the American Conference of Governmental Hygienists [ACGH], which is not a government agency.)

- **TLV-TWA (Time-Weighted Average):** This is the concentration for a normal 8-hour workday or 40-hour workweek. If the MSDS only lists TLV, it usually means a time-weighted average.

To Determine Whether a Product Contains a Highly Toxic Chemical

Check the “Hazardous Ingredients” section of the material safety data sheet (MSDS). If an ingredient is identified as a carcinogen, do not use the product. Products without carcinogens are available for all uses.

All MSDSs must list any ingredient subject to the reporting requirements under Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA), also called the Toxics Release Inventory, or TRI. Screen out products containing these ingredients, which have been identified as chemicals of concern to US EPA.

If you have questions about the health or environmental impacts of specific product ingredients, do a search on the Internet or contact the supplier.

(continued)

6. What's in an MSDS? (continued)

- **TLV-STEL (Short-Term Exposure Limit):** This is the maximum concentration for a 15-minute period (maximum of four such periods per day, with at least 60 minutes between exposure periods, provided that the daily TLV-TWA is not exceeded). This is like the OSHA “ceiling” limit.
- **TLV-C (Ceiling Exposure Limit):** This is the concentration that should not be exceeded even for a split second. This is like the OSHA “peak” limit.

Section II: Hazardous Ingredients (continued)

LD50 or LC50 (Lethal Dose and Lethal Concentration): These terms refer to the dose or concentration of a chemical, which, in experiments, kills 50 percent of the test animals.

Skin or “S”: This means the substance may be absorbed through the skin by liquid contact or through the mucous membranes and eyes by direct contact or airborne contact.

Below are some explanations for the numbers used in this section. (Note that for most substances, mg/m^3 can be converted into ppm, which means parts per million. It is used for measuring the concentration of a gas or vapor in a million parts of air.)

- **mg/m^3 :** This is milligrams of substance per cubic meter of air. The term is most commonly used for measuring concentrations of dusts, metal fumes, or other particles in the air.
- **mg/kg :** This is milligrams of substance per kilogram of body weight. It is used generally to measure toxic chemicals given to experimental animals to ingest.

Section III: Physical/Chemical Characteristics

This section provides critical information about the properties of chemicals such as vapor pressure, vapor density, boiling point and evaporation rate. These measurements can help you learn a lot about hazards of a particular chemical.

Chemical Properties	
Boiling Point	The boiling point of a substance is the temperature at which the liquid boils or becomes a gas. The lower the boiling point, the quicker it evaporates and the easier it is to inhale. Chemicals with boiling points below 100°C (or 212°F) require special caution.
Vapor Pressure	A high vapor pressure indicates that a liquid will evaporate easily. Chemicals which evaporate quickly are called volatile. This means that air concentrations can build up quickly, even though the substance is in liquid form. Liquids with high vapor pressures may be especially hazardous if you are working with them in a confined space or an enclosed area.
Vapor Density	If the vapor density is less than one, it will tend to rise in air. If the vapor density is greater than one, it will fall in air and concentrate in the bottom of tanks or confined spaces.
Appearance and Odor	This information may help identify a substance that spills or leaks in your work area. However, many chemicals are hazardous at levels lower than they can be smelled. Also, many chemicals, such as hydrogen sulfide and ammonia, cause “olfactory fatigue”, which means that workers rapidly lose their ability to smell the substance.
Specific Gravity	If the specific gravity is greater than one, the substance will sink in water; if less than one, it will float on top of water.
Evaporation Rate	This is the rate at which a substance evaporates compared to either ether, which evaporates quickly, or butyl acetate, which evaporates slowly. If the substance has an evaporation rate greater than one, it evaporates faster than the comparison substance. For comparison to butyl acetate, fast evaporation is 3.0 and above, slow is 0.8 and below, medium is anything in between.

(continued)

6. What's in an MSDS? (continued)

Section IV: Fire and Explosion Data

This section provides basic information on the fire hazards of a chemical (flashpoint) and the special precautions necessary to extinguish a fire (extinguishing media).

Flash Point	This is the lowest temperature at which a liquid gives off enough vapor to form a mixture with air that can be ignited by a spark. Liquids with flash points below 100°F are considered flammable, and liquids with flash points between 100 and 200°F are considered to be combustible. Flammable and combustible liquids require special handling and storage precautions.
Extinguishing Media	It should specify what kind of fire extinguisher to use. There are four classifications of fires: Class A for paper and wood, Class B for more flammable materials such as liquids or greases, Class C for electrical fires, and Class D for fires involving metals or metal alloys.

Section V: Reactivity Data

This section tells us whether or not the chemical is likely to break down or react with other substances to cause fires, explosions, or the release of different, even more hazardous, substances.

Section VI: Health Hazard Data

This section describes the health effects of the chemical, including signs and symptoms of exposure and medical conditions made worse by exposure. Acute (short-term) and chronic (long-term) effects of exposure must always be included. Routes of entry (inhalation, skin contact, swallowing) and emergency and first aid procedures must also be included. This section must also contain information on target organs (liver, kidneys or central nervous system), signs or symptoms of exposure, medical conditions generally aggravated by exposure, and emergency First Aid procedures.

Unfortunately, a lot of MSDSs in circulation do not contain complete and accurate health hazard information. They often leave out chronic health information, such as whether a chemical causes cancer or birth defects and most have not been studied for these effects. In fact, Environmental Defense Fund research indicates that currently even the most basic toxicity testing results cannot be found in the public record for nearly 75% of the top-volume chemicals in commercial use.

Section VII: Precautions for Safe Handling and Use

This section should give you information to plan for emergencies (e.g., type of emergency respirators to have on hand, exit routes, and ways to deal with small spills). It also provides procedures for proper waste disposal and precautions for storage and handling. This section is often incomplete for emergency planning purposes.

Section VIII: Control Measures

This section provides information on appropriate respirators, protective clothing, ventilation, and safe work practices. The information usually represents the bare minimum in protection and tends to emphasize protective gear and respirators over engineering controls that could eliminate the problem at the source of exposure.

CHECKING THE ACCURACY OF MSDSs

What can be done if you suspect that the MSDS that you received is not accurate or complete?

- Ask your employer: If an MSDS is not accurate, your employer is responsible for obtaining an accurate, complete MSDS. Ask your employer to request a more accurate MSDS from the supplier or manufacturer.
- Contact the manufacturer: You or your union can contact the manufacturer and ask for a more accurate MSDS. Some MSDSs are also available on-line.
- Contact the NJ Dept. of Health: The Right to Know Program can provide Hazardous Substance Fact Sheets that have more complete information on specific ingredients listed on MSDSs. (www.state.nj.us/health/eoh/rtkweb/ or phone: 609-984-2202).

Sources: American Federation of State, County and Municipal Employees (AFSCME), *How to Read a Material Safety Data Sheet*, www.afscme.org/health/faq-msds.htm *Cleaning for Health, Products and Practices for a Safer Environment*, INFORM, August 2002, www.informinc.org/cleanforhealth.php

7. pH: A Basic Chemical Term

The pH of a chemical tells you if the chemical is an acid, a base (also called alkali or caustic), or neutral. The pH scale goes from 0 to 14, with 7 being neutral (water is neutral with a pH of 7).

pH less than 7 = acid														
pH more than 7 = base														
Strong Acid				Neutral						Strong Base				
0	1	2	3	4	5	6	7	8	9	10	11	12	13	14

The lower the pH (below 7), the stronger the acid. The higher the pH (above 7), the stronger the base. Many organic hydrocarbons (e.g., gasoline, benzene, kerosene, etc.) have almost neutral pHs (close to 7).

Here are some things to remember about pH:

- Chemicals with a pH much lower or much higher than 7 will cause irritation and burns to the part of the body coming into contact with the material.
- Basic chemicals (those with a pH above 7) are much more dangerous to the eyes than are acids. Acids “sit” on the surface of the eyes, if splashed, and can therefore be washed off (if done quickly), often without resulting in permanent damage.
- Base substances rapidly penetrate the eye tissue, often causing quick and lasting damage.
- Store like with like. Chemicals with lower or higher pH should only be stored with chemicals of like pH and never with their opposite or a neutral chemical.

The Fearsome Incompatibles

Keep these...	away from these...	or you may get these
Acids	Bases	Heat Violent Reaction
Acids or Bases	Reactive Metals (Aluminum, Beryllium, Calcium, Lithium, Potassium, Magnesium, Sodium, Zinc Powder), Metal Hydrides	Fire Explosion Hydrogen Gas
Water or Alcohols	Concentrated Acids or Bases Calcium, Lithium, Potassium, Metal Hydrides, Other Water Reactive Wastes	Heat Fire Explosions Flammable and Toxic Gases
Reactive Organic Compounds or Solvents (Alcohols, Aldehydes, Nitrated Hydrocarbons)	Concentrated Acids or Bases, Reactive Metals and Metal Hydrides	Fire Explosion
Cyanide or Sulfide Solutions	Acids	(Toxic) Hydrogen Cyanide Sulfide Gas
Strong Oxidizers (Chlorates, Chlorine, Chrome Acid, Hypochlorites, Nitrates, Perchlorates, Permanganates, Peroxides)	Organic Acids, Concentrated Mineral Acids, Reactive Metals, Metal Hydrides, Reactive Organic Compounds or Solvents, Flammable or Combustible Waste	Fire Explosion

8. The Problems with MSDSs

MSDSs give guidance on using, storing, and handling substances safely on the job and in emergencies such as fires and spills. But MSDSs have some problems. Here's how Anne Jackson, the corporate safety director for Pepperidge Farm Inc., put it:

“The MSDSs I have to work with at Pepperidge Farm usually fall into one of two categories: those written by attorneys for attorneys and those written by chemical engineers for chemical engineers... The origin of the problem is a lack of focus by OSHA and chemical suppliers on the true purpose of the requirement – protecting employees!”

Hospital Study Focuses on MSDS Problems

The Seattle Area Hospital Council conducted a study of 476 MSDSs to see how accurate they were. Here's what they found:

- 53.4% of the MSDSs did not have all the blanks filled in
- 30% were inconsistent (meaning, they included information which contradicted itself)
- 97.1% did not have all of the required elements
- OSHA Permissible Exposure Limits did not appear on 90%
- 89% did not say whether the chemical was a carcinogen

9. An Alternative Source of Information

Through New Jersey's Right to Know program you can obtain factsheets (at no charge) for 1,717 commonly used hazardous substances and chemicals (630 are available in Spanish). The factsheets are easier to read than most MSDSs. (www.state.nj.us/health/eoh/rtkweb/).

The phone number for the Right to Know program is 609-984-2202. The e-mail address is rtk@doh.state.nj.us.

10. Your Rights Under the Law

OSHA requires your company to:

- Have an MSDS for every hazardous chemical used in the workplace and
- Provide you with a copy of the MSDS no later than 15 days after the request, at no charge
- Ensure that MSDSs are readily accessible to all employees during each shift
- Provide training to you and your co-workers prior to handling hazardous chemicals so that you understand the health effects of these chemicals and how to work with them safely

What Is OSHA?

The Occupational Safety and Health Administration (OSHA), is an agency of the U.S. Department of Labor. Congress created OSHA under the Occupational Safety and Health Act of 1970. Prior to 1970, no uniform, comprehensive provisions existed to protect workers against unsafe or hazardous work situations.

OSHA's sole responsibility is to develop mandatory job safety and health standards and enforce them through workplace inspections, employer assistance, and by imposing citations and financial penalties.

OSHA covers all private sector employers and employees in manufacturing, construction, long shoring, shipping, agriculture, law, medicine, charity, disaster relief, organized labor, private education, and religious groups who employ workers.

You Can File an OSHA Complaint

If you are concerned about a health and safety problem on your job and your employer refuses to solve the problem you can file an OSHA complaint. If you file an OSHA complaint you will have to complete an OSHA-7 Complaint Form and it must be faxed, mailed or emailed to the local OSHA Regional Office. You can obtain a complaint form by contacting the OSHA area office or going online (www.osha.gov/as/opa/worker/complain.html#happens).

Your complaint may result in an OSHA investigation. If an OSHA investigation doesn't solve the problem you can still request an OSHA on-site inspection. If OSHA decides not to inspect, they must notify you in writing and give reasons. You may question this decision with the OSHA area director and regional administrator.

The OSHA General Duty Clause

Section 5(a)(1) of the Occupational Safety and Health Act requires that an employer:

“shall furnish to each of his employees employment and a place of employment which is free from recognized hazards that are causing or are likely to cause death or serious physical harm to his employees.”

This is know as the OSHA “general duty clause.”

Summary

1. Many traditional cleaning products, floor strippers and disinfectants are a source for human health and environmental problems. Cleaning products may contain chemicals that cause cancer, reproductive disorders, respiratory ailments (including occupational asthma), eye and skin irritation, central nervous system impairment and other human health effects.
2. There are four basic ways that chemicals can enter your body:
 - Direct contact—on the skin or eyes
 - Absorption—through the skin
 - Ingestion—through the mouth with food
 - Inhalation—through the lungs
3. You can't rely on your sense of smell to protect you from exposure to toxic chemicals.
4. After ingestion, inhalation or skin contact, toxic chemicals as well as their by-products affect the body. For most toxic substances to cause harm there needs to be a sufficient "dose" given. The higher the concentration, the larger the dose. The longer the exposure, the larger the dose.
5. There are two different types of effects that result from toxic exposure. They are acute and chronic. "Acute" means that health effects are felt at the time of exposure or shortly after, or result from a short-term, highly concentrated exposure. "Chronic" is a word that means the ill effects will not be seen for some time after exposure.

6. Material Safety Data Sheets (MSDSs) give detailed information on chemical and physical dangers, safety procedures and emergency response techniques. Employers are required to have MSDSs for every hazardous chemical in the workplace. The MSDSs must be readily accessible to all employees on every shift and in the employee's work area.
7. The pH of a chemical tells you if the chemical is an acid, a base (also called alkali or caustic), or neutral. Chemicals with lower or higher pH should only be stored with chemicals of like pH and never with their opposite or a neutral chemical.
8. MSDSs have some problems. They are sometimes hard to read and are not written for their intended purpose—to protect workers.
9. Through New Jersey's Right to Know program you can obtain factsheets (for no charge) on over 1,700 commonly used hazardous substances and chemicals. The factsheets are easier to read than most MSDSs.
10. OSHA requires employers to provide training to you and your co-workers prior to handling hazardous chemicals. OSHA also requires employers to have MSDSs readily accessible to all employees during each shift. If you are concerned about a health and safety problem on your job and your employer refuses to solve the problem you can file an OSHA complaint.

Evaluation

Activity 1: Chemical Hazards and MSDSs

1. How important is this activity for you and your co-workers?
Please circle one number.

Activity Is Not Important			Activity Is Very Important	
1	2	3	4	5

2. Please put an “X” by the one factsheet you feel is the most important.

1. Cleaning Products Can Make You Sick	6. What’s in an MSDS?
2. Chemical Hazard Awareness	7. pH: A Basic Chemical Term
3. Don’t Trust Your Nose	8. The Problems with MSDSs
4. Dose and the Body’s Response	9. An Alternative Source of Information
5. The Long and Short of It	10. Your Rights Under the Law

3. Which summary point do you feel is most important?
Please circle one number.

Most Important Summary Point				
1.	2.	3.	4.	5.
6.	7.	8.	9.	10.

4. What would you suggest be done to improve this Activity?

Activity 2: Personal Protective Equipment and Chemical Protective Clothing

Purpose

To evaluate the importance, use and limits of personal protective equipment (PPE) and chemical protective clothing in preventing injuries and exposures.

This Activity has two tasks.

Task 1

In your groups, review the factsheets on pages 37-55. Then working together based on the factsheets and your own experience complete the PPE Hazard Worksheet below. After you have completed the worksheet answer the questions on the next page.

PPE Hazard Worksheet	What type(s) of PPE could be used to protect you from these hazards? (You can list more than one)	Are these hazards a problem or concern for you on your job?	
		YES	NO
Hazards	Types of PPE		
Flying particles such as dusts or powders; Chemical gases or vapors, or a combination of these	Type(s) of PPE: Factsheet(s):		
Molten metal, liquid chemicals, acids or caustic liquids that could splash	Type(s) of PPE: Factsheet(s):		
Falling objects from above; the possibility of accidental head contact with electrical hazards; exposed pipes or beams that you could bump with your head	Type(s) of PPE: Factsheet(s):		
Handling, moving, mixing or applying hazardous chemicals to surfaces and equipment	Type(s) of PPE: Factsheet(s):		
Noise that is so loud that you have difficulty hearing normal speech in the work area and/or you have to shout to make yourself heard more than an arm's length away	Type(s) of PPE: Factsheet(s):		
Heavy equipment; heavy falling or rolling objects; sharp objects such as nails or spikes on walking surfaces, exposure to hot substances, slippery surfaces, corrosive or poisonous materials, or exposure to electrical hazards	Type(s) of PPE: Factsheet(s):		

-
1. For each hazard your group checked “YES” on the worksheet, please explain the problem and/or the source of your concern.

 2. In your opinion could any of the hazards be eliminated through higher level controls such as engineering or chemical substitution (See Factsheet 1 for more information)
 - a. If so, what could be done to reduce or eliminate the hazard(s).

 3. Do members of your group wear protective clothing, gloves, and/or glasses?
 - a. If so, do the gloves, clothing or glasses provide the right amount of protection? (See Factsheets 2 through 6 and the Appendix on page xx)
 - b. Are you using gloves that are made for the chemicals you work with?
 - c. Does your eye protection fit properly?
 - d. Can you see clearly when you are wearing your eye protection?

 4. How old are the gloves and/or protective clothing that you are using tonight? How will you know when it’s time to replace them? (See Factsheet 6 for more information.)

 5. For what type of hazards would you use a particulate respirator and can you use it for protection against chemical gases or vapors?

1. PPE and the Hierarchy of Controls

The Occupational Safety and Health Administration (OSHA) requires employers to eliminate, substitute or use engineering controls to reduce hazardous conditions on the job. Employers must apply these *higher level controls* before resorting to the use of *lower level controls* such as warnings, training and procedures and the use of personal protective equipment (PPE). It is important to recognize that **PPE is the least effective way to control a hazard.**

Hierarchy of Controls
1. Elimination/Substitution
2. Engineering
3. Warnings (administrative
4. Training Procedures
5. Personal Protective Equipment

Applying the *Hierarchy of Controls* is the most effective way to deal with workplace hazards. The lower levels of control—warnings, training/procedures, and PPE—are acceptable only when the higher levels of control—elimination, substitution or engineering—are not feasible or do not adequately reduce risk.

Selecting the Right PPE

OSHA strongly recommends that employers conduct a comprehensive *hazard assessment* prior to determining the PPE needed. For each work site, a certificate must be completed that lists the findings of the inspections and the specific protective equipment needed.

In order to select the appropriate PPE employers should:

- Conduct an exposure assessment to determine the type and amount of hazardous exposure
- Take into account the factors affecting PPE selection
- Understand the assigned protection factors
- Know the kinds of PPE and their characteristics

Factors Affecting PPE Selection
Physical configuration of the job site <i>(Will PPE be used in tightly constrained areas with machinery that could snag hoses?)</i>
Medical condition of the person wearing the PPE
Correct fit and comfort of PPE
Resistance to physical stress <i>(Will PPE be used in an area where abrasions, cuts, punctures or tears may occur?)</i>

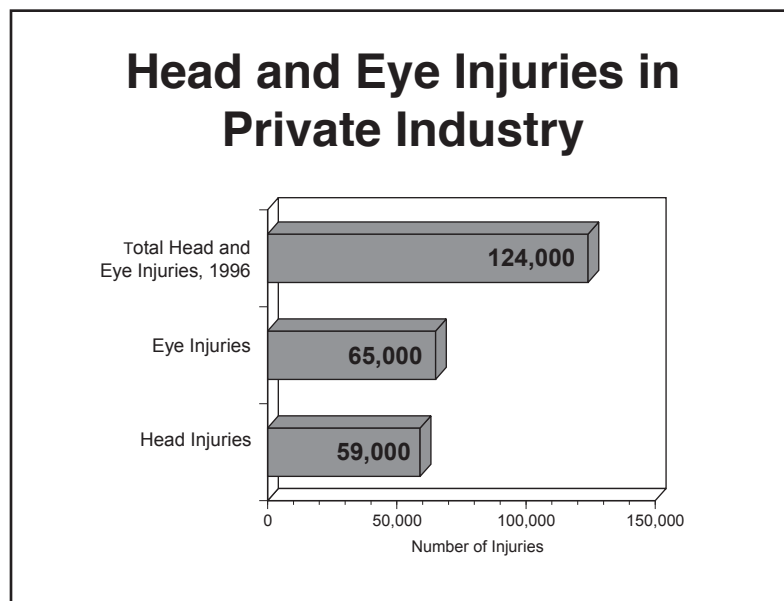
Sources: OSHA Regulations (Standards 29 CFR), *PPE*, 1910.132 and *Non-Mandatory Compliance Guidelines for Hazard Assessment and PPE Selection*, 1910 Subpart I App B. Center for Disease Control, 1998.

2. Eye Protection

Eye protection must be provided where there is a potential for injury to the eyes or face from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or a combination of these. Protective eye equipment should:

- Provide adequate protection against the particular hazards
- Be comfortable to wear under the existing work conditions
- Fit snugly without interfering with a person's movement or vision
- Be durable
- Be capable of being disinfected
- Be kept clean and in good repair

For eye protection, it is important that the protective equipment properly fit the person without interfering with their ability to move or see.



Source: Occupational Safety and Health Administration, *Personal Protective Equipment*, Washington DC, 1998.

3. Hand Protection

There are many types of gloves available to protect against a wide variety of hazards. It is extremely important that you use gloves that are designed for the hazards and tasks of the job you are doing. Gloves made for protection against one hazard may not protect against another hazard even though they may appear to be protecting your hands.

In general, gloves fall into four groups:

- **Leather, canvas or metal mesh** provide protection from cuts, burns, or heat;
- **Fabric and coated fabric** gloves provide protection from dirt and abrasions
- **Chemical and liquid-resistant gloves** provide protection from burns, irritation and dermatitis;
- **Insulating rubber gloves** provide protection from cuts, lacerations and abrasions

Factors That Determine Glove Selection	
✓	Type of chemicals handled
✓	Nature of contact (total immersion, splash, etc.)
✓	Duration of contact
✓	Area requiring protection (hand only, forearm, arm)
✓	Grip requirements (dry, wet, oily)
✓	Thermal protection
✓	Size and comfort
✓	Abrasion/resistance requirements

Source: OSHA Publication 3151-12R, Personal Protective Equipment, 2003.

4. Use the Proper Gloves for Chemicals

If you work with chemicals you must use protective gloves. Unfortunately, MSDSs fall short of making specific recommendations for glove protection.

There is no glove currently available that is resistant to all chemicals, and no glove offers protection for an infinite period of time. That leaves important questions that must be answered including:

- How long should we use the gloves?
- After exposure can we decontaminate the gloves?
- After glove reuse will decontamination cause degradation?

ASTM Standards

In order to help you answer these questions the American Society for Testing and Materials (ASTM) has developed several standards regarding the performance of glove protection (F1407,F739,F903). The ASTM standards address glove degradation, permeation, penetration and breakthrough (*see Factsheet 7 for more information on degradation, permeation, penetration and breakthrough*).

If the gloves you are using have been tested by the manufacturer using the ASTM standards, it will say so on the packaging and you will be able to determine if the gloves are appropriate for the work you are doing. If they have not been tested you should not use them.

The chart below lists some common materials used in making gloves and their protection values (*see the Appendix on pages 131 for a list of various gloves and their protection ratings for specific chemicals. Use it to help you select the most appropriate gloves for your protection*).

MATERIAL	PROTECTION VALUE
Butyl Rubber	Resistant to bases and many organics.
Neoprene	Resistant to mineral acids, organic acids, caustics, alcohol, and petroleum solvents.
Nitrile	Resistant to mineral acids, caustics, and petroleum solvents.
Natural Rubber	Resistant to ketones, alcohols, caustics, and organic acids.
Polyurethane	Resistant to alcohols, bases, aliphatic hydrocarbons
Polyvinyl Chloride (PVC)	Resistant to mineral acids, caustics, organic acids, and alcohols.
Polyvinyl Alcohol (PVA)	Resistant to chlorinated solvents, petroleum solvents and aromatics (not resistant to water).

Sources: *Centers for Disease Control, 1998*. OSHA, May 1995; *Fit the Glove* by Gerard Arotti. Michael Roder, *A Guide For Evaluating the Performance of Chemical Protective Clothing (CPC)*, US Dept. of Health and Human Services; June 1990.

5. Body Protection

There are many varieties of body protection available for specific hazards. The following are examples of workplace hazards that could cause bodily injury:

- Cuts
- Radiation
- Temperature extremes
- Hot splashes from molten metals and other hot liquids
- Impacts from tools, machinery and materials
- Hazardous chemicals

Protective clothing comes in a variety of materials (each effective against particular hazards) including:

- Paper-like fiber used for disposable suits provide protection against dust and splashes.
- Treated wool and cotton adapts well to changing temperatures, is comfortable, and fire-resistant and protects against dust, abrasions and rough and irritating surfaces.
- Duck is a closely woven cotton fabric that protects against cuts and bruises when handling heavy, sharp or rough materials.
- Leather is often used to protect against dry heat and flames. Rubber, rubberized fabrics, neoprene and plastics protect against certain chemicals and physical hazards.
- When chemical or physical hazards are present, check with the clothing manufacturer to ensure that the material selected will provide protection against the specific hazard.

Types of Chemical Protective Clothing (CPC)

If a hazard indicates a need for full body protection against toxic substances or harmful physical agents, the clothing should be carefully inspected before each use; it must fit and function properly. The following are the basic types of CPC available. In emergency situations where the chemical is unknown and airborne, OSHA requires all employers to provide Hazmat team responders with fully encapsulated suits to protect both skin and lungs.

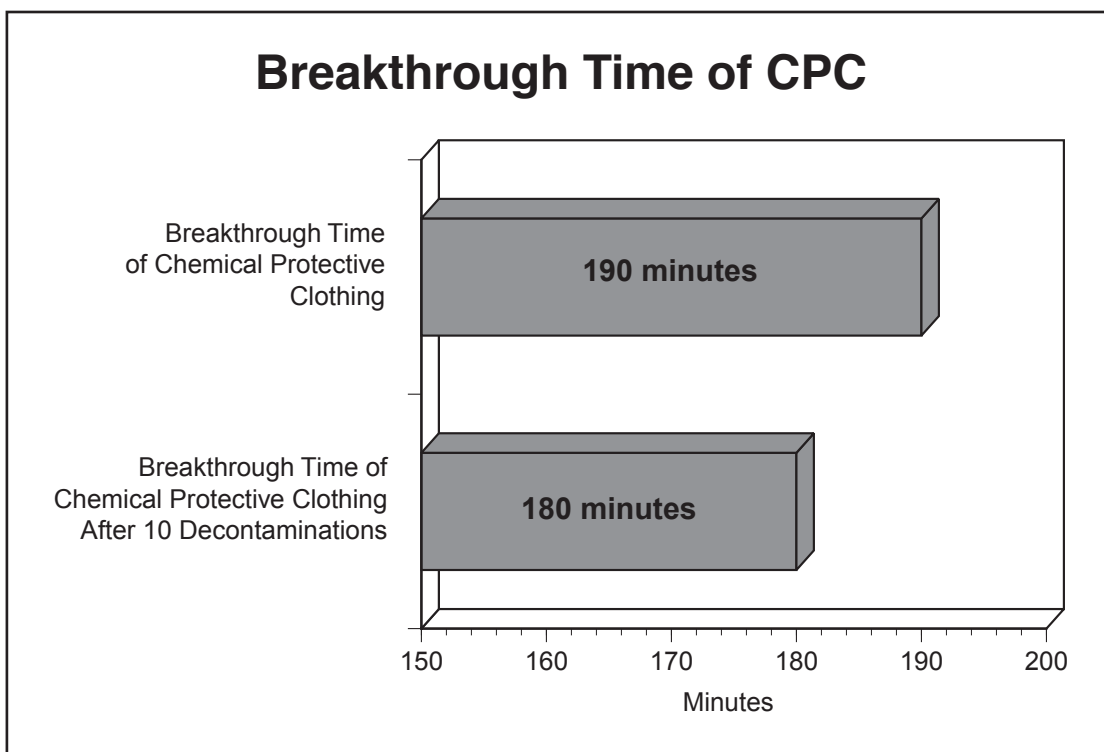
CPC for Emergencies
<p>Fully Encapsulated Suits These suits protect from splashes and vapors. The encapsulated suit is used with a supplied air mask and self-contained breathing apparatus (SCBA) so that a sealed environment is created to keep out all forms of contaminants.</p>
<p>Splash Suits (Non-Encapsulating Suits) The suit consists of a jacket and hood in combination with a pair of pants or bib overalls. The suit provides protection from chemical splashes. It is worn with protective boots and gloves. Duct tape is used to seal any overlap between boot and cuff, glove and sleeve, and hood and respirator.</p>
Other CPC
<p>Aprons, Leggings and Sleeve Protectors These garments do not provide full and complete body protection. However, they do provide additional splash protection when used with non-encapsulating suits.</p>
<p>Face-Shields and Goggles When full-face respirators are used, the face and eyes are protected. In situations where these respirators are not used, face-shields or goggles need to be used to protect the face from chemicals.</p>
<p>Helmets, Hoods and Hair Coverings This type of equipment is used in some situations to provide head protection against chemicals. Safety helmets are also used to protect against head hazards.</p>

Source: OSHA Standard 29 CFR 1910.138, "Hand Protection. OSHA Personal Protective Equipment Program, *General Guidelines for Choosing Personal Protective Equipment*, App. A and B. OSHA Publication 3151-12R, Personal Protective Equipment, 2003.

6. The Limits of CPC

CPC can leak. The leakage has a lot to do with *breakthrough time*—the point when a chemical *permeates* or passes through the protective clothing.

A Department of Health and Human Services study found that the breakthrough time of CPC can decrease from 190 minutes to 180 minutes after 10 decontaminations (disinfecting or sterilizing the clothing).



Evaluating CPC

There are three things to keep in mind when evaluating the limits of protective clothing:

1. Permeation

When the chemical passes through the protective material, this is called permeation. For example, even though a plastic glove looks solid, it still has many pores and open spaces. The proper glove will provide a barrier, but over time and with extended use, chemicals eventually pass through.

2. Degradation

When the chemical corrodes, dissolves or damages the protective clothing, this is called degradation. If the chemical changes the protective properties of the clothing, then it will no longer be protective. Sometimes degradation is visible—the material may be puckered, brittle and/or eroded. Sunlight and high temperatures can cause degradation.

3. Penetration

When a chemical passes through a garment/glove by way of holes or imperfections, this is called penetration. Penetration can occur at zippers or stitched seams and through pin holes or tears in a garment or glove.

7. Hearing Protection

Overexposure to noise can lead to permanent hearing loss. If you are experiencing any of the symptoms listed below then you may be overexposed to noise.

- Difficulty hearing normal speech in the work area
- Shouting to make oneself heard more than an arm’s length away
- Ringing in the ears after leaving the work area
- After work, dulled or muffled hearing that disappears after 14 hours (It’s hard to hear normal conversation, TV, radio, etc.)
- Headaches, dizziness or other health conditions related to stress (for example: high blood pressure, fatigue, etc.)
- Co-workers who are hard of hearing

Decibels and Exposure Limits

Decibels (dB) measure the loudness of noise. **When decibels go up by 3, loudness doubles.** For example, 93 dB is twice as loud as 90 dB.

In general, the louder the noise, the shorter the amount of time you can be exposed before hearing protection is required. For example, you can be exposed to a noise level of 90 dB for 8 hours per day before hearing protection is required. But if the noise level reaches 115 dB hearing protection is required if the exposure exceeds 15 minutes.

Permissible Noise Exposures	
Duration Per Day in Hours	Sound Level in dB
8	90
6	92
4	95
3	97
2	100
1.5	102
1	105
.5 (30 minutes)	110
.25 (15 minutes)	115

Types of Hearing Protection

The basic types of hearing protection include:

- **Single-use earplugs** made of waxed cotton, foam, silicone rubber or fiberglass wool. They are self-forming and, when properly inserted, they work as well as most molded earplugs.
- **Pre-formed or molded earplugs** must be individually fitted by a professional and can be disposable or reusable. Reusable plugs should be cleaned after each use.
- **Earmuffs** require a perfect seal around the ear. Glasses, facial hair, long hair or facial movements such as chewing may reduce the protective value of earmuffs.

Ear Plugs Not Always Effective

A National Institute for Occupational Safety and Health (NIOSH) study shows that as actually worn in the facility, earplugs **are less than half as effective** in protecting workers' hearing as their manufacturers claim. In 15 different facilities, 420 workers had their hearing tested while wearing one of four types of earplugs. The results were compared with the earplug manufacturers' claims. None of the plugs provided the claimed percentage of effectiveness.

Ear Muffs May Provide Even Less Protection

Ear muff manufacturers also dangerously overstate the effectiveness of their product. In fact, earmuffs may provide even less protection than earplugs. A study of shipyard workers showed there was greater hearing impairment among the workers who had used earmuffs than those who had used plugs. A study concluded that plastic plugs were more comfortable to wear than earmuffs, and therefore provided the best protection for long-term use.

Sources: NIOSH, *A Practical Guide to Preventing Hearing Loss*, 96-110, Appendix B, "Hearing Protection Devices," July, 1999 OSHA Publication 3151-12R, Personal Protective Equipment, 2003.

8. Foot/Leg Protection

If you face possible foot or leg injuries from falling or rolling objects, crushing or penetrating materials, exposure to hot substances, corrosive or poisonous materials, or exposure to electrical hazards then you will need foot and leg protection.

When to Wear Foot or Leg Protection	
✓	When heavy objects such as barrels or tools might roll onto or fall on the feet
✓	Working with sharp objects such as nails or spikes that could pierce the soles or uppers of ordinary shoes
✓	Exposure to molten metal that might splash on feet or legs
✓	Working on or around hot, wet or slippery surfaces
✓	Working when electrical hazards are present

Foot and leg protection choices include the following:

- **Leggings** protect the lower legs and feet from heat hazards such as molten metal or welding sparks.
- **Metatarsal guards** protect the instep area from impact and compression.
- **Toe guards** fit over the toes of regular shoes to protect the toes from impact and compression hazards.
- **Combination foot and shin guards** protect the lower legs and feet, and may be used in combination with toe guards when greater protection is needed.
- **Safety shoes** have impact-resistant toes and heat-resistant soles that protect the feet against hot work surfaces common in roofing, paving and hot metal industries. The metal insoles of some safety shoes protect against puncture wounds. Safety shoes may also be designed to be electrically conductive to prevent the buildup of static electricity in areas with the potential for explosive atmospheres or nonconductive to protect workers from workplace electrical hazards.

Source: OSHA Publication 3151-12R, Personal Protective Equipment, 2003.

9. Head Protection

Serious head injuries can kill or impair you for life. Wearing a properly fitted safety helmet or hard hat is one of the easiest ways to protect your head from injury. Hard hats can protect you from impact and penetration hazards as well as from electrical shock and burns.

If you are working on a job where objects might fall from above or there is a possibility of accidental head contact with electrical hazards, or you could bump your head against fixed objects (e.g., exposed pipes or beams) then you should be wearing a hard hat. Whenever you are working below others who are using tools or working under a conveyor belt, you should be wearing a hard hat.

Types of Hard Hats

Class A:

- General service (building construction, shipbuilding, lumbering)
- Good impact protection but limited voltage protection

Class B:

- Electrical/Utility work
- Protects against falling objects and high-voltage shock and burns

Class C:

- Designed for comfort, offers limited protection
- Protects against bumps from fixed objects, but does not protect against falling objects or electrical shock

Hard hats must have a hard outer shell and a shock-absorbing lining that includes a headband and straps that suspend the shell from 1 to 1 1/4 inches away from the head. This provides shock absorption during an impact and ventilation during normal wear. Protective headgear must meet ANSI Standard Z89.1-1986 (Protective Headgear for Industrial Workers) or provide an equivalent level of protection (see Factsheet 5 for more information on ANSI Standards).

Source: OSHA Publication 3151-12R, Personal Protective Equipment, 2003.

10. Respirators

Air-Purifying Respirators (APRs)

These are the most commonly used and misused respiratory protection devices. They involve the use of cartridges or canisters that contain either filters (to screen out dusts, fumes, or mists) or activated charcoal or other absorbent material (to screen out organic vapors, acids, gases, etc.) to reduce exposures of the wearer. APRs come in two types:

- **Negative-pressure** types (either half-face or full-face), where filtered air is not forced into the mask
- **Powered-air** types, where filtered air is forced into the mask

The powered-air respirator is more protective and more comfortable than the negative-pressure type because it forces air to flow out, thereby helping to prevent inward leakage of contaminants. APRs generally leak at the seal between the face and the mask. That's why you need to be fit-tested.

Supplied Air Respirators

This respirator involves wearing a mask, which is hooked up to a "fresh," uncontaminated, outside source of air by a hose. This fresh, unfiltered air (no cartridges or canisters are used) is forced into the face-piece. This type of equipment offers more protection than the air-purifying respirators but can be cumbersome to wear.

Self-contained breathing apparatus (SCBA)

This is similar to a supplied-air respirator but the fresh uncontaminated source of air comes from a "bottle" or "tank" worn on the back. **This is the only type of respirator protection permitted for use in atmospheres that are Immediately Dangerous to Life or Health (IDLH).**

Particulate Respirators

Particulate respirators are the simplest, least expensive, and least protective of the respirator types available (*For more information on different types of respirators see Task 2*).

Particulate respirators only protect against particles such as dusts or powders. They do not protect against chemicals, gases, or vapors, and are intended only for low hazard levels.

Particulate respirators are “air-purifying respirators” because they clean particles out of the air as you breathe. Even if you can’t see the particles, there may be too many in the air for this respirator to provide adequate protection.

Dust Masks Are Not Respirators!

Dust masks should not to be regarded as PPE, and if they are “required,” it is due to a lack of understanding of the nature of their function. They can sometimes provide comfort against hot/cold air and nuisance (non-toxic) dusts, fumes, or mists, so you can say they “protect” against discomfort. But they are not respirators and they ARE NOT to be used for protection against airborne toxic particulate matter or for gases or vapors. They are never to be used as protection from illness or injury.

NIOSH Approved Particulate Respirators

The National Institute for Occupational Safety and Health (NIOSH), part of the Centers for Disease Control and Prevention (CDC), tests and certifies respirators for use by workers to protect against workplace hazards. Respirators certified by NIOSH will say “NIOSH Approved” and may have a certification number.

(continued)

10. Respirators *(continued)*

However, NIOSH only certifies respirators against specific hazards. **Just because a respirator is certified does not mean it will protect against all hazards.** NIOSH-certified respirators are supplied with *Approval Labels* that identify the hazards that the respirator is approved to protect against. If you are buying a respirator, you should check the Approval Label to be sure that it has been certified against the hazards you want protection against. NIOSH-approved disposable respirators are marked with the manufacturer's name, the part number (P/N), the protection provided by the filter (e.g. N-95), and "NIOSH."

Types of Particulate Respirators

An N-95 respirator is one of nine types of disposable particulate respirators. Particulate respirators are also known as "air-purifying respirators" because they protect by filtering particles out of the air you breathe. Workers can wear any one of the particulate respirators for protection against diseases spread through the air- if they are NIOSH approved and if they have been properly fit-tested and maintained.

Disposable Particulate Respirators (Filtering Facepiece)	
Type	Description
N95	Filters at least 95% of airborne particles. Not resistant to oil.
N99	Filters at least 99% of airborne particles. Not resistant to oil.
N100	Filters at least 99.7% of airborne particles. Not resistant to oil.
R95	Filters at least 95% of airborne particles. Somewhat resistant to oil.
R99*	Filters at least 99% of airborne particles. Somewhat resistant to oil.
R100*	Filters at least 99.7% of airborne particles. Somewhat resistant to oil.
P95	Filters at least 95% of airborne particles. Strongly resistant to oil.
P99*	Filters at least 99% of airborne particles. Strongly resistant to oil.
P100	Filters at least 99.7% of airborne particles. Strongly resistant to oil.

11. Cleaning and Maintenance of PPE

Here are some guidelines for the cleaning and maintenance of PPE:

- All protective equipment should be maintained in good condition and replaced when no longer suitable for its purpose.
- PPE should not be used longer than the time indicated by the manufacturer.
- PPE should be cleaned, disinfected and thoroughly examined before it is used again.
- A record should be kept of the condition, cleaning, disinfection, and examination of personal protective equipment.
- When PPE is sent off site to be cleaned, care should be taken to make sure that the contractor fully understands the precautions necessary for handling contaminated clothing.

Task 2

You have been offered a job that will require you to wear a respirator. The employer has assured you that he has the proper equipment for the job.

In your groups review the factsheets on pages 58-64, then working together make a list of questions you should ask about the respirator before taking the job.

Questions you would ask the employer before taking the job:

1.

2.

3.

4.

5.

12. Respirators: A Last-Ditch Control

Respirators are extremely limited as a control device. Their use must be carefully monitored. Here are some of the major problems:

Respirators...

- Are hot and uncomfortable
- Often fit poorly (allowing the toxic substance to get in)
- Put extra stress on the heart and lungs
- Limit conversation (and therefore safety)
- Do not offer any protection whatsoever against many chemicals
- Do not stop the toxic chemical from getting into the environment
- Do not prevent skin exposure
- Do not prevent eye exposure

13. What OSHA Says About Respirators

Here's what OSHA says in its respiratory protection standard (29 CFR 1910.134):

“...In the control of those occupational diseases caused by breathing air contaminated with harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors, the primary objective shall be to prevent atmospheric contamination. This shall be accomplished as far as feasible by accepted engineering control measures (for example, enclosure or confinement of the operation, general and local ventilation and substitution of less toxic materials). When effective engineering controls are not feasible, or while they are being instituted, appropriate respirators shall be used.”

According to OSHA, any workplace where respirators are necessary to protect the health of workers or whenever respirators are required, the employer must establish and implement a written respiratory protection program.

Written Respiratory Protection Programs Must Include:
Procedures for selecting respirators.
Medical evaluation for workers who are using respirators.
Fit testing.
Procedures for proper use of respirators in routine and emergency situations.
Procedures and schedules for proper cleaning and maintaining of respirators.
Procedures to ensure air quality and flow of breathing for atmosphere-supplying respirators.
Training in the proper use of respirators, their limitations and their maintenance.
Procedures for regularly evaluating the effectiveness of the program.

14. Types of Respirators

Air-Purifying Respirators (APRs)

These are the most commonly used and misused respiratory protection devices. They involve the use of cartridges or canisters that contain either filters (to screen out dusts, fumes, or mists) or activated charcoal or other absorbent material (to screen out organic vapors, acids, gases, etc.) to reduce exposures of the wearer. APRs come in two types:

- **Negative-pressure** types (either half-face or full-face), where filtered air is not forced into the mask
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This respirator involves wearing a mask, which is hooked up to a “fresh,” uncontaminated, outside source of air by a hose. This fresh, unfiltered air (no cartridges or canisters are used) is forced into the face-piece. This type of equipment offers more protection than the air-purifying respirators but can be cumbersome to wear.

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Particulate Respirators

Particulate respirators are the simplest, least expensive, and least protective of the respirator types available. **Particulate respirators only protect against particles. They do not protect against chemicals, gases, or vapors, and are intended only for low hazard levels.** Particulate respirators are “air-purifying respirators” because they clean particles out of the air as you breathe. Even if you can’t see the particles, there may be too many in the air for this respirator to provide adequate protection.

Dust Masks Are Not Respirators!

Dust masks should not to be regarded as PPE, and if they are “required,” it is due to a lack of understanding of the nature of their function. They can sometimes provide comfort against hot/cold air and nuisance (non-toxic) dusts, fumes, or mists, so you can say they “protect” against discomfort. But they are not respirators and they **ARE NOT** to be used for protection against airborne toxic particulate matter or for gases or vapors. They are never to be used as protection from illness or injury.

(continued)

14. Types of Respirators *(continued)*

NIOSH Approved Particulate Respirators

The National Institute for Occupational Safety and Health (NIOSH), part of the Centers for Disease Control and Prevention (CDC), tests and certifies respirators for use by workers to protect against workplace hazards. Respirators certified by NIOSH will say “NIOSH Approved” and may have a certification number.

However, NIOSH only certifies respirators against specific hazards. Just because a respirator is certified does not mean it will protect against ALL hazards. NIOSH-certified respirators are supplied with Approval Labels that identify the hazards that the respirator is approved to protect against. If you are buying a respirator, you should check the Approval Label to be sure that it has been certified against the hazards you want protection against. NIOSH-approved disposable respirators are marked with the manufacturer’s name, the part number (P/N), the protection provided by the filter (e.g. N-95), and “NIOSH.”

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Source: NIOSH Guide to the Selection and Use of Particulate Respirators Certified Under 42 CFR 84, Publication No. 96-101, January 1996, <http://www.cdc.gov/niosh/npptl/topics/respirators/>

15. What Is Fit Testing?

Respirators are not made to fit every kind of face. As a result, OSHA mandates that employers make certain the respirators properly fit each of us.

Most respirators are made to fit the average male face. Scars, dentures, high cheekbones, etc. can make it next to impossible to get a proper fit with a respirator. In order for a respirator to be effective it has to create a seal with the wearer's face. Fit testing must be repeated annually and cannot be performed on workers with facial hair or other objects that can interfere with a proper face to respirator seal.

Fit testing involves giving a respirator to a worker and instructing him or her on how to wear the mask. The respirator must then be put on and adjusted so it is snug but comfortable. To achieve this, the contractor may have to provide you with a number of respirators made by a variety of manufacturers.

A qualitative fit test involves having an irritant like smoke, which will cause coughing, or a chemical with a strong smell, like banana oil, sprayed all around the respirator while you are wearing it. If the respirator doesn't fit, you'll cough or smell bananas.

OSHA Updates Fit Testing Procedures

OSHA recently increased the rigors of qualitative fit testing, requiring that specific exercises be conducted and specific information be read during fit testing to ensure a proper fit. For more information, see OSHA Regulations (Standards - 29 CFR) 1910.134 App. A, Fit Testing Procedures (Mandatory).

16. Respirator Maintenance and Care

Under the OSHA respiratory standard, the following respirator maintenance and care must be performed by the employer:

- Respirators issued for the exclusive use of an employee must be cleaned and disinfected to maintain sanitary conditions.
- Respirators that are shared, emergency-use respirators, or respirators used in fit testing must be cleaned and sanitized after each use.
- Respirators must be stored to protect them from damage, contamination, dust, sunlight, extreme temperatures, excessive moisture, and damaging chemicals.
- All respirators must be inspected before each use and during cleaning.
- All respirators maintained for emergency use must be inspected monthly and checked for proper function after each use.
- All SCBAs must be inspected monthly.
- Written records of maintenance must be maintained for emergency-use respirators.

Summary

1. Using the *hierarchy of controls* employers must eliminate, substitute or use engineering controls to reduce hazardous conditions on the job. PPE is the least effective control in the hierarchy of controls.
2. OSHA strongly recommends that employers conduct a comprehensive *hazard assessment* prior to determining the PPE needed.
3. Eye protection must be provided where there is a potential for injury to the eyes or face from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or a combination of these.
4. When hand protection is required it is extremely important that you use gloves that are designed for the hazards and tasks you are doing.
5. If a hazard indicates a need for full body protection against toxic substances or harmful physical agents, the clothing should be carefully inspected before each use; it must fit and function properly.
6. There are three things to keep in mind when evaluating the limits of protective clothing: **permeation, degradation, and penetration.**
7. Overexposure to noise can lead to permanent hearing loss. There are three basic types of hearing protection. **Single-use earplugs** are made of waxed cotton, foam, silicone rubber or fiberglass wool. They are self-forming and, when properly inserted, they work as well as most molded earplugs. **Pre-formed or molded earplugs** that are individually fitted by a professional can be disposable or reusable. Reusable plugs should be cleaned after each use. The third type is **earmuffs** require a perfect seal around the ear.
8. If you face possible foot or leg injuries from falling or rolling objects, crushing or penetrating materials, exposure to hot substances, corrosive or poisonous materials, or exposure to electrical hazards then you will need foot and leg protection.

9. If you are working on a job where objects might fall from above, or there is a possibility of accidental head contact with electrical hazards, or you could bump your head against fixed objects (e.g., exposed pipes or beams) then you should be wearing a hard hat.
10. Respirators are extremely limited as a control device. Their use must be carefully monitored. There are four types of respirators including **air-purifying respirators (APRs), supplied air respirators, self-contained breathing apparatus (SCBA), and particulate respirators.**
11. All protective equipment should be maintained in good condition and replaced when no longer suitable for its purpose.
12. According to OSHA, any workplace where respirators are necessary to protect the health of the employee or whenever respirators are required, the employer must establish and implement a written respiratory protection program.
13. Respirators are not made to fit every kind of face. As a result, OSHA mandates that employers make certain the respirators properly fit each of us. Fit testing involves giving a respirator to a worker and instructing him or her on how to wear the mask. The respirator must then be put on and adjusted so it is snug but comfortable. To achieve this, the company may have to provide you with a number of respirators made by a variety of manufacturers.
14. Dust masks should not to be regarded as PPE. They are not respirators and they **ARE NOT** to be used for protection against airborne toxic particulate matter or for gases or vapors. They are never to be used as protection from illness or injury.
15. If you are buying a respirator, you should check the Approval Label to be sure that it has been certified against the hazards you want protection against. NIOSH-approved disposable respirators are marked with the manufacturer's name, the part number (P/N), the protection provided by the filter (e.g. N-95), and "NIOSH."

Evaluation

Activity 2: Personal Protective Equipment

1. How important is this activity for you and your co-workers?

Please circle one number.

Activity Is Not Important			Activity Is Very Important	
1	2	3	4	5

2. Please put an “X” by the one factsheet you feel is the most important.

	1. PPE and the Hierarchy of Controls		9. Head Protection
	2. Eye Protection		10. Respirators
	3. Hand Protection		11. Cleaning and Maintenance of PPE
	4. Use the Proper Gloves for Chemicals		12. Respirators: A Last-Ditch Control
	5. Body Protection		13. What OSHA Says About Respirators
	6. The Limits of CPC		14. Types of Respirators
	7. Hearing Protection		15. What Is Fit Testing?
	8. Foot/Leg Protection		16. Respirator Maintenance and Care

3. Which summary point do you feel is most important?

Please circle one number.

Most Important Summary Point				
1.	2.	3.	4.	5.
6.	7.	8.	9.	10.
11.	12.	13.	14.	15.

4. What would you suggest be done to improve this Activity?

Activity 3: Lockout/Tagout

Purpose

To understand lockout/tagout procedures and how they can reduce the risk of injury at work.

This activity has one task.

Task

The trainer will assign your group one of the scenarios below. Then in you groups, review the factsheets on pages 76-87 and answer the questions on pages 74-75.

Scenario I:

John, a newly hired maintenance mechanic was adjusting a power press. But he was not sure about his new employer's procedures, so he asked the operator who informed him that the previous mechanic never shut down the press for these types of adjustments.

John considered performing a lockout/blockout but feeling the pressure to get the job done quickly, he decided to make the adjustment without performing the procedures.

During a test cycle, John put his hand into the press, attempting to adjust a screw that tensioned the die. He sustained a severe crushing injury to his right thumb and index finger, resulting in the partial amputation of the right thumb and a total amputation of the index finger.

Scenario II:

The third shift electrician was out sick again and the press operators from the first and second shifts had already called several times complaining about a broken light fixture. The production manager told the third shift supervisor to get the fixture installed before the first shift arrived in the morning.

The supervisor informed the third shift janitor that he would install the fixture. The fixture was located directly above the press. The supervisor, who was an “authorized” employee acting as the helper, instructed the janitor to install the wiring.

The janitor was connecting the wiring while the circuit remained energized and was not wearing electrical protective equipment. He was electrocuted when his head contacted the wire hangers for a drop ceiling as his right hand was touching an energized conductor.

(continued)

3. What types of energy are present at your facility? How should employees be protected from each energy source?

Energy Type	How Isolated?
a.	
b.	
c.	
d.	

4. Based on the factsheets and your own experience, are there any suggestions you could make to improve your employer's Lockout/Tagout procedures?

1. Control of Hazardous Energy Sources (Lockout/Tagout)

The standard for the control of hazardous energy sources (lockout/tagout) covers servicing and maintenance of machines and equipment in which the unexpected energizing or start-up of machines or equipment, or release of stored energy could cause injury to employees.

The rule generally requires that energy sources for equipment be turned off or disconnected and that the switch either be locked or labeled with a warning tag.

OSHA General Lockout-Tagout Requirements

The standard requires employers to do the following:
1. Develop an energy control program.
2. Use locks when equipment can be locked out.
3. Ensure that new equipment or overhauled equipment can accommodate locks.
4. Employ additional means to ensure safety when tags rather than locks are used by implementing an effective tagout program.
5. Identify and implement specific procedures (in writing) for the control of hazardous energy, including preparation for shutdown, equipment isolation, lockout/tagout application, release of stored energy and verification of isolation.
6. Institute procedures for release of lockout/tagout, including machine inspection, notification and safe positioning of employees, and removal of the lockout/tagout device.
7. Obtain standardized locks and tags that indicate the identity of employee using them and which are of sufficient quality and durability to ensure their effectiveness.
8. Require that each lockout/tagout device be removed by the employee who applied the device.
9. Conduct inspections of energy-control procedures annually.
10. Train employees in the specific energy control procedures with training reminders as part of the annual inspections of the control procedures.
11. Adopt procedures to ensure safety when equipment must be tested during servicing, when outside contractors are working at the site, and when multiple lockout is needed for a crew servicing equipment, and when shifts or personnel change.

2. Hazardous Energy Can Kill

The following cases were documented by the National Institute for Occupational Safety and Health (NIOSH) as part of an investigation of fatal incidents in which workers were exposed to hazardous energy.

Worker Crushed By Trash Compactor

A 38-year-old worker at a county sanitary landfill died after falling into a large compactor used to bale cardboard for recycling. The cardboard was lifted 20 feet by a belt conveyor and fed through a 20- by 44-inch opening into a hopper. The hopper had automatic controls that activated the baler when enough material collected in the baling chamber. When the baler was activated, material in the chamber was compressed by a ram that entered the chamber from the side. Excess material above the chamber was trimmed by a shearer.

On the day of the incident, cardboard jammed at the conveyor discharge opening. Without stopping, de-energizing, or locking out the equipment, the victim rode the conveyor up to the discharge opening to clear the jam. He fell into the hopper and the baling cycle was automatically activated, amputating his legs. The victim bled to death before he could be removed from the machine (*Colorado Dept. of Public Health and Environment, 1994*).

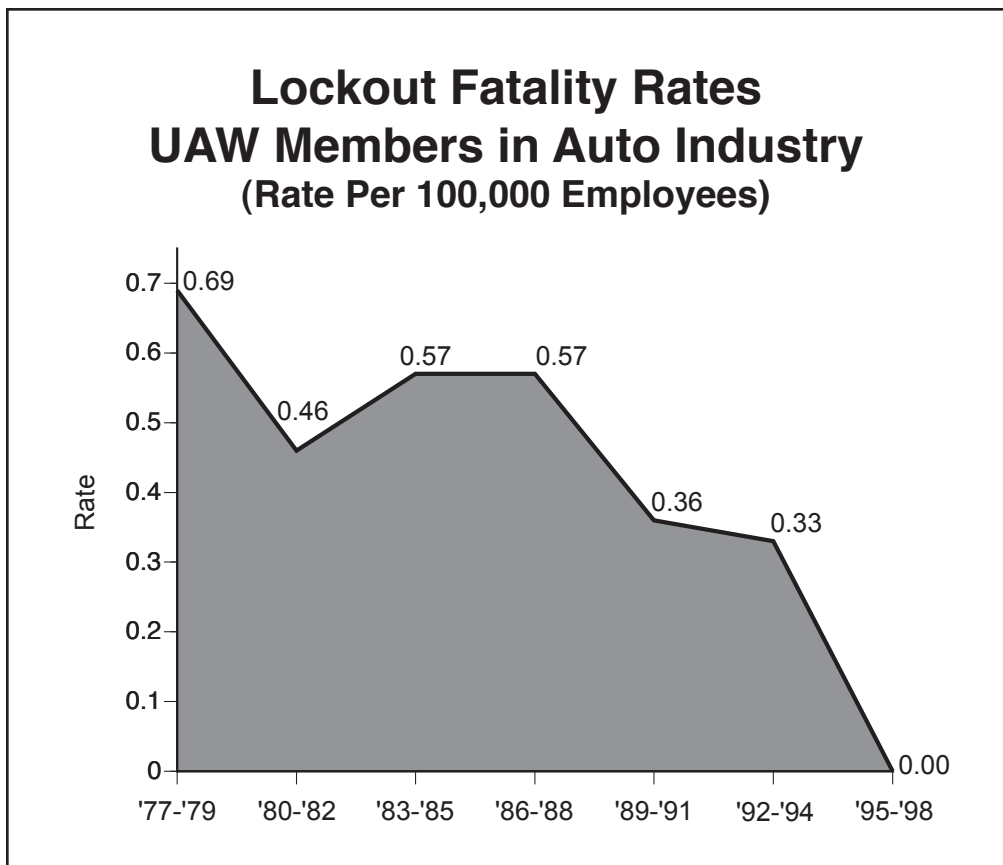
Janitor Dies Trapped In Linen Dryer

A 33-year-old janitorial worker died after he was trapped inside a linen dryer at a hospital laundry while cleaning plastic debris from inside of the dryer drum. The cleaning task (which usually took 15 minutes to an hour) involved propping open the door to the dryer with a piece of wood and entering the 4-by 8-foot dryer drum. The melted debris was removed by scraping and chiseling it with screwdrivers and chisels. The dryer was part of an automated system that delivered wet laundry from the washer through an overhead conveyor to the dryer, where it was dried during a 6-minute cycle with air temperatures of 217 to 230 degrees. The system control panel was equipped with an error light that was activated if the dryer door was open, indicating that the dryer was out of service.

On the night of the incident, the victim propped the door open and entered the dryer drum without de-energizing or locking out the dryer. He began to clean the inside of the drum. Although the error light had been activated when the door was propped open, the signal was misinterpreted by a coworker, who restarted the system. When the system was restarted, the overhead conveyor delivered a 200-pound load of wet laundry to the dryer-knocking out the wooden door prop, trapping the victim inside, and automatically starting the drying cycle. The victim remained trapped inside until the cycle was completed and was discovered when the load was discharged from the dryer. He died thirty minutes later of severe burns and blunt head trauma (*Mass. Dept. of Public Health, 1992*).

3. Proper Lockout/Tagout Procedures Save Lives

In 1997, the United Auto Workers (UAW) Health and Safety Department presented a statistical analysis to OSHA showing the effectiveness of UAW negotiated lockout programs in conjunction with the OSHA lockout standard. From 1989 to 1997, auto industry lockout-related fatalities declined approximately 20% each year. From 1994 to 1997 there were no lockout fatalities in the industry.



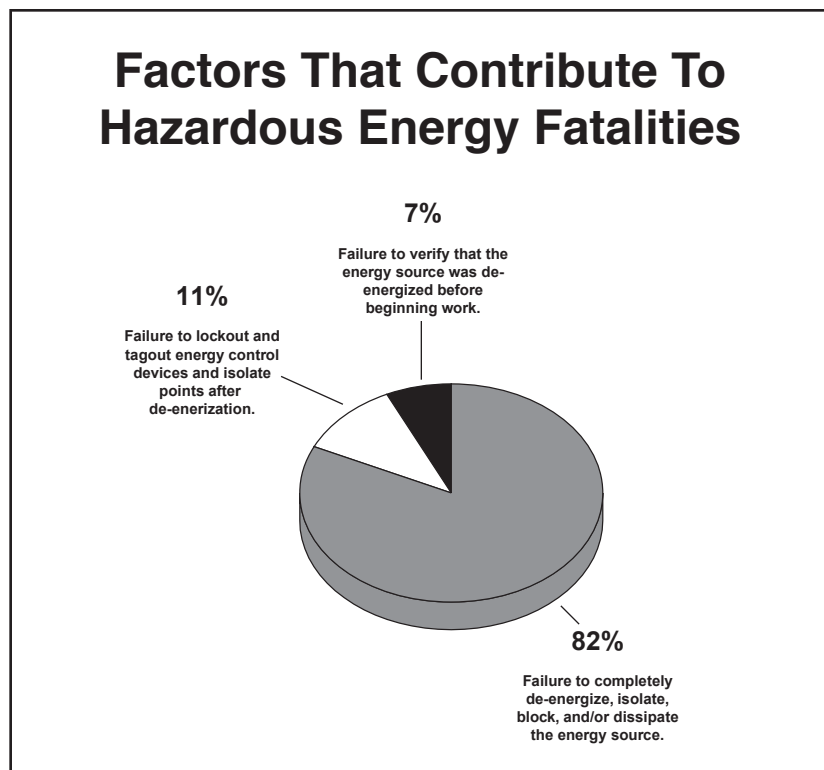
Source: UAW Health and Safety, *Statistics Prove UAW Negotiated Lockout Programs Successful*, September, 1997.

4. Factors That Lead to Hazardous Energy Fatalities

Between 1982 and 1997, NIOSH investigated 1,281 fatal workplace incidents. Of these, 152 involved installation, maintenance, service, or repair tasks on or near machines, equipment, processes, or systems.

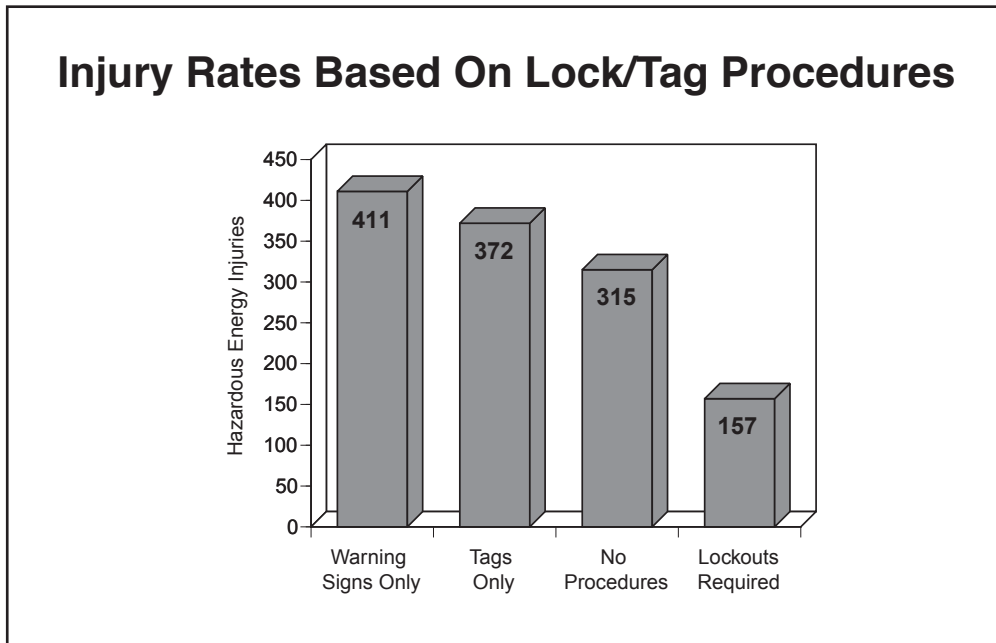
Review of these 152 incidents suggests that three related factors contributed to these fatalities:

- Failure to completely de-energize, isolate, block, and/or dissipate the energy source
- Failure to lockout and tagout energy control devices and isolation points after de-energization
- Failure to verify that the energy source was de-energized before beginning work



5. Tags Without Locks Can Be Dangerous

A study by the National Institute of Occupational Safety and Health (NIOSH) showed that tags or warning signs alone, without locks, actually increased the rate of injury. In the chart below, injury rates for different warning procedures are compared.*



Because of the problems associated with using tags, OSHA has determined that lockout is a more reliable means of de-energizing equipment than tagout and that it should always be the preferred method used by employees.

OSHA believes that, except for limited situations, the use of lockout devices will provide a more secure and more effective means of protecting employees from the unexpected release of hazardous energy or start-up of machines and equipment.

*The study reviewed workers' compensation claims filed in Ohio in 1983. The rate or ratio is based on a formula that divides the number of lockout injuries by the total number of employees, multiplied by 100,000.

Source: OSHA 3120, *Control of Hazardous Energy (Lockout/Tagout)*, Revised 1997.

6. When Is a Lockout /Tagout Procedure Required?

OSHA requires a procedure if equipment can be started or stored energy released.

Examples of sources of energy:

- **Electrical:** energized circuits still connected to the equipment.
- **Mechanical:** movements of gears, saw blades, or conveyers.
- **Pneumatic:** control devices on conveyers.
- **Hydraulic:** loading and unloading platforms.
- **Chemical:** release of chemical from tanks, pipes, or valves.
- **Thermal:** heat from steam-operated equipment.
- **Stored energy:** energy released from springs under tension or compression, or from gravity itself (like an unsupported elevator).

7. The Elements of a Good Plan or Procedure

At each plant, the written plan or procedure will vary to fit the needs and practices at that plant.

There are eight elements required to be outlined in a written plan or procedure:

1. The purpose
2. Responsibility (i.e. authorized employee)
3. Preparation – steps to install locks and tags and notify supervisors and workers in the area
4. Return to service – steps to remove locks and tags and notify supervisor and workers in the area
5. Different procedures for different types of equipment
6. Group lock and tag procedures
7. What to do as the shift changes
8. Inspection system

8. Count to Six Before Starting to Work

1. Prepare for shutdown.

- a. Locate all the energy sources that need to be locked out: electrical, mechanical, hydraulic, pneumatic, thermal, etc.
- b. Notify all affected employees in the work area that the equipment is going to be locked or tagged out.

2. Shut down the equipment.

- a. Turn it off and disconnect all energy sources.

3. Isolate the equipment.

- a. Set the switch, valve, or other device(s) so that the equipment is isolated from its energy source(s).

4. Lockout or tagout.

- a. Apply the lock or tag. If the equipment has controls that can be locked out, tags may not be used unless the employer can demonstrate that tagout provides the same degree of protection that locks do.

5. Release all stored energy.

- a. Relieve pressure in pipes, steam, chemical, and gas.
- b. Release tension in springs.
- c. Bleed hydraulic lines.
- d. Block equipment that could move. Residual hydraulic pressure or gravity can move a machine.

6. Test for a zero-energy state.

- a. Try to turn equipment on. It shouldn't come on. If it does, start over. Repeat steps 1 through 5 until you are sure it can't be started.
- b. Be sure to turn off after testing.

9. Four Steps for Removing Locks and Tags

1. Inspect the equipment.

Has the equipment been reassembled correctly after servicing or maintenance?

2. Check the work area.

Make sure that no tools or equipment have been left behind. Make sure that all workers are in a safe location.

3. Tell someone.

Notify workers close-by that the equipment is going to be turned on.

4. Remove the locks and tags.

They should be removed only by the workers who attached them.

10. Am I “Affected” or “Authorized”?

The OSHA standard classifies employees as “affected employees” and “authorized employees.” Each category has a different training requirement.

An **affected employee** is one whose job requires them to operate equipment that is subject to lockout/tagout or whose job requires work in areas where a lockout/tagout is used.

- Training for affected employees who operate equipment must include instructions on the purpose and use of the procedure of lockout/tagout.
- Affected employees who work in the area must be instructed in the procedure of lockout/tagout.

An **authorized employee** is one whose job requires them to physically lockout or tagout machinery/equipment in order to perform service or maintenance. Training for authorized employees shall include:

- Recognition of hazardous energy sources.
- Identification of the types and magnitude of energy sources in the workplace.
- Explanation of the method and means for isolation and control of hazardous energy.

11. Hardware Requirements for Locks and Tags

OSHA requires the following:

Lock Requirements

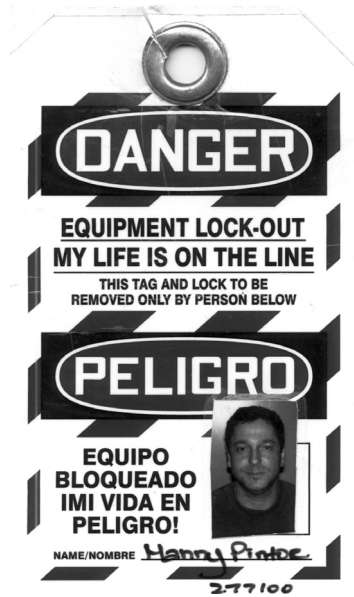
- They must be the same size, shape, color.
- They must have a place for the individual's name.
- They can be used only for the purpose of lockout.
- They must be durable.

Tag Requirements

- They must all have the same print and format.
- They must have a place for the individual's name.
- They must be weatherproof and durable.
- They require a warning.
- They must be used for lockout/tagout purposes only.
- They must be able to withstand a 50-pound pull without detaching.

Source: OSHA Standard 1910.147.

12. Safety Tag Examples



Summary

1. The standard for the control of hazardous energy sources (lockout-tagout) covers servicing and maintenance of machines and equipment in which the unexpected energizing or start-up of machines or equipment, or release of stored energy could cause injury to employees.
2. The United Auto Workers Union has demonstrated that effective lockout programs significantly reduce hazardous energy fatalities.
3. A NIOSH study identified poor procedures (e.g., failure to de-energize, isolate, block, and/or dissipate the energy source; failure to lockout and tagout energy-control devices; and failure to verify that the energy source was de-energized before beginning work) as a major contributing factor in hazardous energy fatalities.
4. Because of the problems associated with using tags, OSHA has determined that lockout is a more reliable means of de-energizing equipment than tagout and that it should always be the preferred method used by employees.
5. OSHA requires a procedure if equipment can be started or stored energy released. At each plant, the written plan or procedure will vary to fit the needs and practices at that plant.
6. The four steps for removing locks and tags are:
 1. Inspect the equipment
 2. Check the work area
 3. Tell someone
 4. Remove the locks and tags

7. The OSHA standard classifies employees into two categories—affected employees (workers who operate equipment that is subject to lockout/tagout) and authorized employees (workers who physically lockout or tagout equipment). Each category has a different training requirement.

Evaluation

Activity 3: Lockout/Tagout

1. How important is this activity for you and your co-workers ?

Please circle one number.

Activity Is Not Important			Activity Is Very Important	
1	2	3	4	5

2. Please **put an "X" by the one factsheet** you feel is the most important.

	1. Control of Hazardous Energy Sources (Lockout/Tagout)		7. The Elements of a Good Plan or Procedure
	2. Hazardous Energy Can Kill		8. Count to Six Before Starting to Work
	3. Proper Lockout/Tagout Procedures Save Lives		9. Four Steps for Removing Locks and Tags
	4. Factors That Lead to Hazardous Energy Fatalities		10. Am I "Affected" or "Authorized"?
	5. Tags Without Locks Can Be Dangerous		11. Hardware Requirements for Locks and Tags
	6. When Is a Lockout/Tagout Procedure Required?		12. Safety Tag Examples

3. Which summary point do you feel is most important?

Please circle one number.

Most Important Summary Point				
1.	2.	3.	4.	5.
6.	7.			

4. What would you suggest be done to improve this Activity?

Activity 4: Confined Spaces

Purpose

To learn more about the multiple hazards of confined spaces and what you should do in an emergency situation.

This Activity has three tasks.

Task 1

Any one of us could be the first to spot a potential emergency at a worksite. We all must know what to do to protect ourselves and co-workers in an emergency.

Below you will find an emergency scenario and on the next page a list of eight procedures (listed alphabetically) that are typical actions to follow when there is an emergency. These eight procedures are printed on sets of cards that the trainers will pass out to your groups. The cards list the actions that you would take as the first person to identify that an emergency situation exists.

Read the scenario below and then arrange the cards in the order of the steps you would take to respond to the emergency. What would you do first, second, third, etc.

To replicate some of the confusion of an emergency situation, your group will have only **five minutes** to arrange the cards.

Scenario:

The night shift supervisor tells Jason and his co-worker Brittany that they will be cleaning out the inside of a seven-foot deep fermentation tank. The tank is large enough for one person to fit inside. Jason tells Brittany to get the cleaning supplies and equipment while he takes a look at how much work they will need to do in order to clean the tank. When Brittany arrives she notices that the lid located at the top of the tank is open. She points her flashlight into the opening and sees Jason lying face down at the bottom of the tank.

If you were Brittany what would you do?

Eight Emergency Response Actions: (listed alphabetically)

ALERT (others nearby)	Tell a nearby co-worker or anyone else nearby that there's a problem; get help.
CONTROL (the hazard)	Control or contain any spill or leak of hazardous material that is part of the incident.
CRITIQUE	Review the response to determine how to improve procedures for the next time.
DECONTAMINATE (the injured)	Wash or rinse the contamination off the injured person
EVACUATE	Make sure all unnecessary and uninvolved personnel are cleared from the problem area.
NOTIFY (government agencies)	Make a phone call to the appropriate government agency to let them know an incident has occurred (EPA, OSHA, DOT, etc.)
RESCUE (the injured)	Get in and get the downed person(s) out (so they can receive medical attention).
SIZE UP (the situation)	Take time to think through the situation as you see it and decide on what you will do.

Task 2

Now review the factsheets on pages 98-101 and see if you change your mind about what to do first.

Eight Emergency Response Actions: (listed alphabetically)

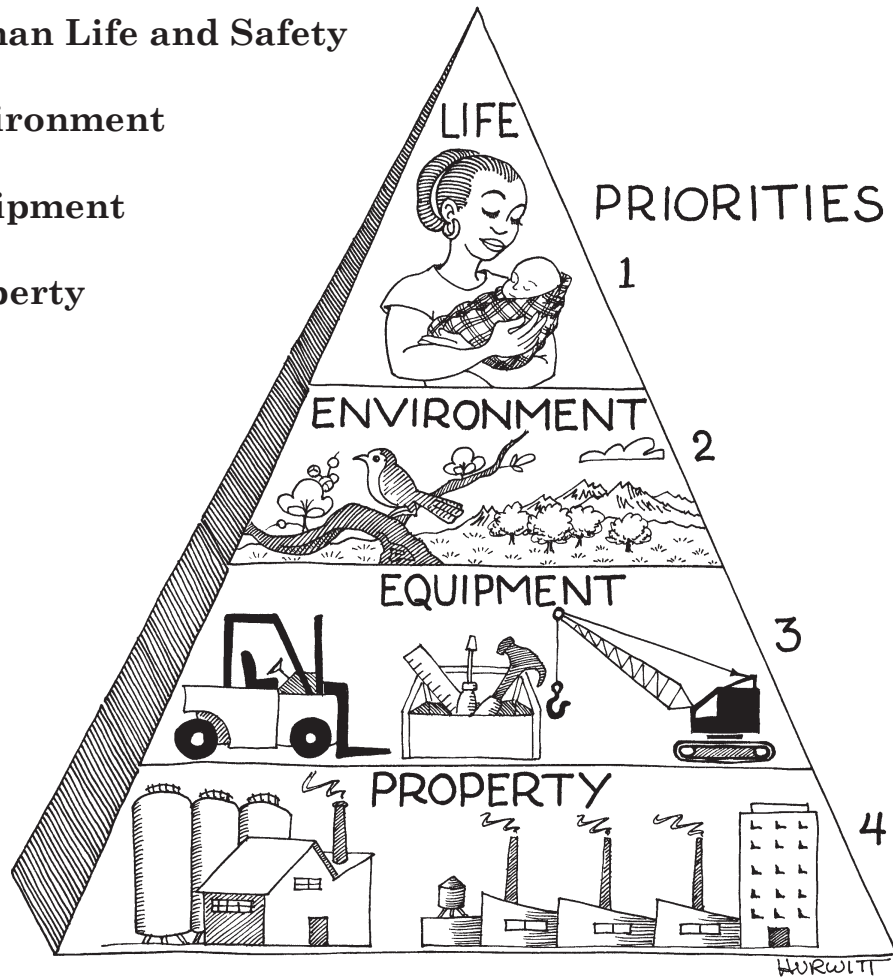
ALERT (others nearby)	Tell a nearby co-worker or anyone else nearby that there's a problem; get help.
CONTROL (the hazard)	Control or contain any spill or leak of hazardous material that is part of the incident.
CRITIQUE	Review the response to determine how to improve procedures for the next time.
DECONTAMINATE (the injured)	Wash or rinse the contamination off the injured person
EVACUATE	Make sure all unnecessary and uninvolved personnel are cleared from the problem area.
NOTIFY (government agencies)	Make a phone call to the appropriate government agency to let them know an incident has occurred (EPA, OSHA, DOT, etc.)
RESCUE (the injured)	Get in and get the downed person(s) out (so they can receive medical attention).
SIZE UP (the situation)	Take time to think through the situation as you see it and decide on what you will do.

1. Setting Priorities: Life Comes First

Getting Our Priorities Straight

Emergency responders should act to protect:

1. Human Life and Safety
2. Environment
3. Equipment
4. Property



Life Comes First

The first priority is to **protect human life and rescue the injured where possible.**

Sounds easy, right? Unfortunately, it is not easy to live by this simple rule during an emergency because of the following:

We try a rescue when we shouldn't.

Human nature is such that we cannot stand to see a fellow worker go down and not try to jump in and rescue. Unfortunately, on some jobsites this instinct will almost always kill us.

According to a NIOSH study of **confined spaces** facilities, over 60 percent of all fatalities were **would-be rescuers becoming casualties because they jumped in to rescue a co-worker.**

It's hard, but we need to learn to think before we jump in. Sometimes "protecting life first" means your own. This is done by isolating the area and **keeping everyone out until people with proper training and protective equipment arrive.**

Protecting the Environment

Sometimes emergency response actions taken to contain a spill or fire can result in widespread environmental contamination.

When dealing with hazardous substances, **minimizing the contamination and adverse effects to the environment**—air emissions, leaks to the bodies of water into flood control or sewer lines—is a higher priority than putting out a fire to save a facility.

Protecting Equipment and Property

Only when life and the environment are protected should we move to protect equipment, buildings and structures.

2. Alert, Think, Then Act: Emergency Response Procedures

The following six procedures always apply to an emergency situation and should be done in the following order:

1. **Alert others nearby.** This is always the first action to take. Notify others that an emergency is taking place so that on-site and off-site help can be called immediately.
2. **Size up the situation.** Before you make any move, think first—do not become a casualty yourself. Consider the options: evacuation, rescue, hazard control, etc.
3. **Evacuate.** Get everyone who may be in harm's way out of the problem area and wait for people with proper training and equipment to arrive.
4. **Rescue the injured. Your first priority is to protect your health and safety; then assist or obtain assistance for the injured.** In almost all situations you will need the help of others, specialized equipment, and proper personal protective equipment before any rescue can be attempted. Decontamination of the person is a case-specific decision depending on how toxic the chemical is and how life threatening the situation is. Whenever handling an injured and contaminated person, be sure that the emergency medical, ambulance, and hospital personnel are kept informed. Some states and communities have laws or policies prohibiting transportation of a contaminated person who has not been decontaminated.

- 5. Control the hazard.** The next priority is to contain or control the hazard. In most cases, this should be done by the emergency response team because they have the training, experience and equipment to do the job safely. Prompt equipment shutdown or isolation are steps trained personnel may take to minimize the hazards. **Protecting life and the environment is a higher priority than saving the facility or property.**
- 6. As a follow-up, critique your response.** After an incident, always critique the responses to identify ways to improve response procedures for the next time. This should include the need for more training, drills, equipment or modification of the emergency response plan.

Task 3

It was later determined that Jason's death was the result of a lack of oxygen in the fermentation tank. If you were told to do the same job what would you do to make sure the tank is safe to work in?

In your groups review the factsheets on pages 104-121. Then based on your own experience and the factsheets, make a list of questions that you would ask the supervisor before entering the tank.

Questions you would ask the supervisor. (Please make a list.)

1.

2.

3.

4.

5.

6.

3. What Is a Confined Space?

A **confined space** includes any space large enough and shaped so that a worker can enter and perform assigned work along with one of the following characteristics:

- The space has limited or restricted openings for entry and exit
- The space is not designed for continuous worker occupancy

Examples of Confined Spaces	
Storage Tanks	Ventilation and Exhaust Ducts
Pits	Sewers
Silos	Tunnels
Vats	Utility Vaults
Degreasers	Pipelines
Reaction or Process Vessels	Firewalls
Boilers	

4. Hazards of Confined Space Work

Confined spaces can be hazardous because they often contain airborne, mechanical or physical hazards. Asphyxiation is the leading cause of death in confined spaces, according to OSHA statistics. While hazards may already exist before you enter a confined space, other hazards can be created by the work activity. That's why pre-entry and continuous or repeated monitoring are essential.

Confined spaces are hazardous because they may:

- have less than 19.5 percent oxygen or greater than 23.5 percent oxygen (See Factsheet 5 for more information)
- have contaminants in the air that make the atmosphere toxic (See Factsheet 6 for more information)
- have flammable / combustible / explosive atmospheres present or generated by the work activity
- not be protected against entry of water, gas, steam, toxic or corrosive chemicals, or radiation contamination and fields that could trap, suffocate or otherwise harm a worker
- have mechanical hazards of moving machinery that can harm a worker if activated during occupancy of the confined space
- have physical hazards, causing slips, falls or engulfment
- have poor natural ventilation
- restrict entry for rescue purposes
- have extreme temperatures

Source: Workers Compensation Board of BC, Hazards of Confined Spaces for Municipalities and the Construction Industry, www.WorkSafebc.com.

5. Atmospheric Hazards: Too Much or Too Little Oxygen

Oxygen Deficiency (Too Little)

Many confined-space emergencies, are caused by reduced levels of oxygen in the air. Oxygen deficiency can be a killer in emergency response situations.

What Causes Oxygen Deficiency?

Some of the common causes of oxygen deficiency include:

- Oxygen is used up during combustion—for example, by propane space heaters, during cutting or welding, and by internal combustion engines
- Oxygen can be replaced by other gases—for example, welding gases or gases forced into the space to prevent corrosion
- Micro-organisms use up oxygen—for example, in sewer lines and fermentation vessels.

Physiological Effects

The body requires oxygen to live. If the oxygen concentration in the air decreases, the body reacts in various ways. Death occurs rapidly when the oxygen level decreases to six percent.

The legal limit is never to work in an atmosphere with less than 19.5 percent oxygen. As the chart below shows, decreasing oxygen levels can greatly impair our judgment, making us victims rather than helpers in an emergency situation.

Physiological Effects of Oxygen Deficiency	
%Oxygen (by volume) at Sea Level	
21-19	Nothing abnormal.
16-12	Loss of peripheral vision, increased breathing volume, accelerated heartbeat, impaired attention and thinking, impaired coordination.
12-10	Very faulty judgement, very poor muscular coordination, intermittent respiration. Muscular exertion causes fatigue that may cause permanent heart damage.
10-6	Nausea, vomiting, inability to perform vigorous movements, or loss of all movement, unconsciousness, followed by death.
Less than 6	Spasmodic breathing, convulsive movements, death in minutes.

Too Much Oxygen

Too much oxygen is not as common a hazard in confined spaces but when it occurs it greatly increases the risk of fire or explosion. Materials that would not normally catch fire or burn in normal air may do so very quickly and easily in confined spaces where there oxygen levels are high.

The only way to know how much oxygen is present in a confined space is to use an oxygen monitor. It must be in good working order and properly maintained and calibrated. The alarm must be set at the right level. Someone trained to use the monitor must test the air before anyone enters a confined space.

Sources: Workers Compensation Board of BC, Hazards of Confined Spaces for Municipalities and the Construction Industry, www.WorkSafebc.com. OSHA Regulation: Permit-Required Confined Spaces - 1910.146; Fire Fighting Fundamentals, Seattle Fire Department and Washington State Fire Service Training, Seattle, WA, 1989.

6. Atmospheric Hazards: Toxic Gases

Gases in the air can result in an atmosphere that is toxic to workers and may result in injury or death. Some toxic gases typically found in confined spaces are listed below.

Beware of Toxic Gases in Confined Spaces		
Contaminant (Gas)	The Danger	Looks or Smells Like
Argon (Ar)	Displaces oxygen May accumulate at bottom	Colorless, odorless
Carbon dioxide (CO ₂)	Displaces oxygen Toxic May accumulate at bottom	Colorless, odorless
Carbon monoxide (CO)	Toxic—asphyxiant (causing suffocation)	Colorless, odorless (No Warning)
Chlorine (Cl ₂)	Toxic—lung and eye irritant May accumulate at bottom	Greenish yellow color and sharp pungent odor
Gasoline Vapours	Fire and explosion May accumulate at bottom	Colorless with a sweet odor
Hydrogen sulfide (H ₂ S)	Extremely flammable Very toxic—causes lung failure May accumulate at bottom	Colorless with rotten egg odor
Methane (CH ₄)	Fire and explosion May accumulate at top	Colorless, odorless (No Warning)
Nitrogen (N ₂)	Displaces oxygen	Colorless, odorless (No Warning)
Nitrogen dioxide (NO ₂)	Toxic—severe lung irritant May accumulate at bottom	Reddish brown, pungent odor
Sulfur dioxide (SO ₂)	Toxic—severe lung irritant May accumulate at bottom	Colorless, rotten suffocating odor
Oxygen (O ₂)	Low levels—asphyxiant High levels—causes spontaneous combustion, explosion	colorless, odorless

Monitoring and Removal

The concentration of a substance inside a confined space is determined by using a calibrated and properly set up air monitor with the correct sensor. The monitor will sound an alarm before an exposure limit is reached.

In most cases, fans are used to ventilate the space and bring in clean outside air. Air testing and ventilation are the best ways to ensure that workers are not placed at risk from hazardous gases. Harmful substances must be eliminated whenever possible.

7. Non-Permit and Permit Required Confined Spaces and Procedures

A *non-permit* confined space means the space has no hazards that could cause death or serious physical harm. However, if a confined space contains one of the following conditions it is considered a *permit-required confined space*, or “permit space.”

- A hazardous atmosphere or material that could engulf a worker
- Conditions inside the confined space that could trap or asphyxiate a worker (such as inwardly converging walls or sloped floor)
- Any other recognized serious safety or health hazard

After it's been determined that a space requires a permit an employer must develop and implement a written program for the space. The program should include the following procedures:

- Implementing necessary measures to prevent unauthorized entry
- Identifying and evaluating permit space hazards before allowing employee entry
- Testing atmospheric conditions in the permit space before entry operations and monitoring the space during entry
- Performing appropriate testing for the following atmospheric hazards in this sequence: oxygen, combustible gases or vapors, and toxic gases or vapors
- Establishing and implementing the means, procedures and practices to eliminate or control hazards necessary for safe permit space entry operations

- Identifying employee job duties
- Providing and maintaining, at no cost to the employee, personal protective equipment and any other equipment necessary for safe entry and requiring employees to use it
- Ensuring that at least one attendant is stationed outside the permit space for the duration of entry operations
- Coordinating entry operations when employees of more than one employer are working in the permit space
- Implementing appropriate procedures for summoning rescue and emergency services, and preventing unauthorized personnel from attempting rescue
- Establishing, in writing, and implementing a system for the preparation, issue, use and cancellation of entry permits
- Reviewing established entry operations annually and revising the permit space entry program as necessary
- Implementing the procedures that any attendant who is required to monitor multiple spaces will follow during an emergency in one or more of those spaces

(continued)

7. Non-Permit and Permit Required Confined Spaces and Procedures *(continued)*

Nº 173

CONFINED SPACE ENTRY PERMIT

1. PERMIT SPACE TO BE ENTERED: _____

2. PURPOSE FOR ENTRY: _____

3. DATE OF ENTRY: _____ DURATION OF ENTRY: _____

4. AUTHORIZED ENTRANTS:

I have been properly trained for safe entry into this tank and understand my duties.

5. ATTENDANTS:

I have been properly instructed of my duties and properly trained in case of an emergency.

6. ENTRY SUPERVISORS:

I certify that all necessary precautions have been taken to make this tank safe for entering and carrying on prescribed work during the specified time.

_____ maintenance foreman / assistant foreman
 _____ production supervisor

7. HAZARDS OF THE PERMIT SPACE TO BE ENTERED.

	YES	NO	N/A
A: LACK OF OXYGEN	_____	_____	_____
B: COMBUSTIBLE GASES	_____	_____	_____
C: COMBUSTIBLE DUSTS	_____	_____	_____
D: COMBUSTIBLE VAPORS	_____	_____	_____
E: TOXIC GASES	_____	_____	_____
F: TOXIC VAPORS	_____	_____	_____
G: CHEMICAL CONTACT	_____	_____	_____
H: ELECTRICAL HAZARDS	_____	_____	_____
I: MECHANICAL HAZARDS	_____	_____	_____
J: TEMPERATURE	_____	_____	_____
K: OTHER	_____	_____	_____

8. ISOLATING THE PERMIT SPACE BEFORE ENTRY

- _____ CLEANED AND WASHED
- _____ LOCKOUT/TAGOUT
- _____ VENTILATION
- _____ BLANKING, BLOCKING, BLEEDING
- _____ EXTERNAL BARRICADES

9. ACCEPTABLE ENTRY CONDITIONS

I certify that the tank was washed, cleaned, purged, and neutralized (if necessary) and therefore is acceptable for entry. Also, production personnel were notified that tank entry will be in progress.

_____ plant manager/designee

DO NOT DESTROY THIS PERMIT
AFTER CANCELLATION THIS ENTRY PERMIT MUST BE RETAINED
BY EMPLOYER FOR AT LEAST ONE YEAR.

POSTED AT CONFINED SPACE

To be Filed in Engineering Department

8. Contractors and Confined Spaces

If a contractor takes you to a jobsite to work in a confined space that is owned or maintained by an employer and the space contains one of the following conditions it is considered a *permit-required* confined space, or “permit space.”

- A hazardous atmosphere or material that could engulf a worker
- Conditions inside the confined space that could trap or asphyxiate a worker (such as inwardly converging walls or sloped floor)
- Any other recognized serious safety or health hazard

Employers are required to inform contractors that entry into a permit space is only allowed through compliance with a permit space program that meets the requirements of the confined space standard.

Employer Requirements

To make the contractor’s entry into the permit-required space safe, the employer must:

- Provide to the contractor information on the elements that make the space in question a permit space, including hazards identified
- Provide to the contractor information on any precautions or procedures that the employer has implemented in or near permit spaces where contractor employees will be working
- Coordinate entry operations with the contractor when the employer’s employees will be working in or near permit spaces
- Debrief the contractor at the conclusion of entry operations regarding the permit space program followed and regarding any hazards confronted or created in permit spaces during entry operations.

Contractor Requirements

In addition to complying with the permit space requirements that apply to all employers—including the proper training—contractors must:

- Obtain any available information regarding permit space hazards and entry operations from the host employer
- Coordinate entry operations with the host employer, when both host employer personnel and contractor personnel will be working in or near permit spaces
- Inform the host employer of the permit space program that the contractor will follow and of any hazards confronted or created in permit spaces, either through a debriefing or during the entry operation

Sources: OSHA Regulation: Permit-Required Confined Spaces - 1910.146 Mark H. Stromme, J.J. Keller & Associates, Inc., *Contractors Beware: OSHA's General Industry Confined Space Standard May Apply to You*, 2003.

9. OSHA Requires Training For Confined Spaces

The OSHA standard requires employers to train four groups of workers.

Entrants (*workers*) must be trained to recognize hazards, communicate regularly with attendants, use personal protective equipment properly, and exit a confined space without assistance (self-rescue).

Attendants must be trained to be aware at all times of how many workers are in the space, know and recognize the effects of hazards both within and outside the space, maintain contact with entrants, deal with unauthorized persons, summon rescue services, and be prepared to properly perform rescue duties, such as using retrieval lines.

Entry supervisors must be trained in how to determine acceptable entry conditions, prepare entry permits, and identify when to terminate or cancel a permit if conditions are no longer appropriate.

Rescue team members must get the same training as entrants and training in proper use of personal protective equipment and rescue equipment. At least one member of the rescue team must have training and be certified in basic first aid and CPR (cardiopulmonary resuscitation) skills. In addition, rescue teams must practice making confined-space rescues at least once a year.

10. Recommendations for Safe Entry: A Checklist

The following checklist was compiled from the OSHA standard and recommendations by NIOSH. It is helpful in determining if the space is safe. Do not enter a confined space unless it is necessary and until you have considered every question.

1. Permit

- Has a confined-space permit been issued?
- Was it completed and signed by a person qualified to authorize permits?
- Does it list all hazards or conditions that must first be evaluated?
- Does it list all needed protective measures (such as lockout, ventilation, PPE, special tools, escape and rescue procedures)?

2. Isolation and Lockout

- Have all employees and supervisors been notified?
- Has the space been isolated from other systems?
- Has electrical equipment been locked out?
- Have disconnects been used where possible?

(continued)

10. Recommendations for Safe Entry: A Checklist *(continued)*

2. Isolation and Lockout *(continued)*

- Has mechanical equipment been blocked, checked, and disengaged where necessary?
- Have lines under pressure been blanked and bled?
- Have all entrances to confined spaces been properly marked with warning signs?

3. Atmospheric Testing and Monitoring

- Has the air been checked for oxygen? (It must be at least 19.5 percent and not more than 23.5 percent.)
- Has the air been checked for toxic vapors or gases?
- Has the air been checked for flammable vapors? (It must not exceed 10 percent of the Lower Explosive Limit.)
- Did a qualified person do the testing?
- Were all monitoring instruments calibrated and used properly?

4. Ventilation

- Has the space been ventilated before entry?
- Could ventilating to reduce one hazard create another hazard? For example, solving an oxygen deficiency problem through ventilation may place a particular chemical within its explosive range.
- Will ventilation be continued during entry?

- Is the air intake for the ventilation system located in an area that is free of combustible dusts and vapors and toxic substances?
- If the atmosphere was found unacceptable and then ventilated, was it retested before entry?

5. Cleaning

- Has the space been cleaned before entry?
- Was the space steamed?
- If so, was it allowed to cool?
- Are there pockets of residual material?

6. Respirators, PPE, Rescue Equipment, and Safe Tools

- Does the entry permit list all required PPE?
- Is special clothing required and available (chemical suits, boots, gloves, goggles)?
- Is special rescue equipment required?
- Is respiratory protection required (supplied air, SCBA, or air purifying)?
- Are special tools (e.g. spark proof) required and available?
- Can you get through the opening of the space with a respirator and other PPE on?

(continued)

10. Recommendations for Safe Entry: A Checklist *(continued)*

7. Training

- Have you been trained in hazard recognition, methods of safe work in confined spaces, communication methods, use of PPE and self-rescue?
- Has the attendant been trained?
- Has the entry supervisor been trained?
- Have you been trained in self-rescue?
- Are you aware of the potential hazards for this confined space (slick surfaces, noise, extreme temperature)?

8. Standby Attendant

- Will there be a standby attendant on the outside in constant visual or auditory communication with person on the inside? (Name should be on permit.)
- Will the standby attendant be able to see and/or hear the person inside at all times?
- How many people in the space will the attendant be required to monitor?

9. Rescue

- Are there company procedures available to be followed in case of an emergency?
- Will members of the rescue team be able to reach you within three to five minutes?
- Is there at least one rescue person on all shifts certified in CPR and first aid?
- Have you been trained in self-rescue?
- Is rescue equipment (such as safety lines, hoists, and harnesses) available for use by the attendant or rescue team?

10. Communication

- Are there effective communication procedures for entrants and attendants to remain in constant contact?
- Is special communication equipment available, where needed?

Sources: OSHA *Confined Space Pre-entry Check List* - 1910.146, App D; "A Guide to Safety in...Confined Spaces," U.S. Department of Health and Human Services, NIOSH, July 1978 and OSHA Rule on Confined Space (58 FR 4462), April 15, 1993.

Summary

1. According to a NIOSH study of **confined spaces** facilities, over 60 percent of all fatalities were **would-be rescuers becoming casualties because they jumped in to rescue a co-worker.**
2. It's hard, but we need to learn to think before we jump in. Sometimes "protecting life first" means your own. **This is done by isolating the area and keeping everyone out until people with proper training and protective equipment arrive.**
3. A **Confined Space** includes any space large enough and shaped so that a worker can enter and perform assigned work along with one of the following characteristics:
 - The space has limited or restricted openings for entry and exit
 - The space is not designed for continuous worker occupancy
4. Confined spaces can be hazardous because there are atmospheric, mechanical or physical hazards. Atmospheric hazards can include lack of oxygen or presence of a flammable, combustible or toxic substance. Other hazards include engulfment, slippery surfaces, and heat exhaustion.
5. Many confined-space emergencies, are caused by reduced levels of oxygen in the air. Oxygen deficiency can be a killer in emergency response situations. Too much oxygen is not as common a hazard in confined spaces but when it occurs it greatly increases the risk of fire or explosion.
6. Gases in the air can result in an atmosphere that is toxic to workers and may result in injury or death. The concentration of a substance inside a confined space is determined by using a calibrated and properly set up air monitor with the correct sensor. The monitor will sound an alarm before an exposure limit is reached.

7. A *non-permit* confined space means the space has no hazards that could cause death or serious physical harm. However, if a confined space contains one of the following conditions it is considered a *permit-required confined space*, or “permit space.”
 - A hazardous atmosphere or material that could engulf a worker
 - Conditions inside the confined space that could trap or asphyxiate a worker (such as inwardly converging walls or sloped floor)
 - Any other recognized serious safety or health hazard
8. When you work for a contractor in an permit-required confined space your contractor must work with the company that owns or maintains the space to insure that you are protected and that the proper procedures for working in the space are followed.
9. Employers and contractors are responsible for insuring that you have been properly trained before you enter a permit-required space. The four types of employees that must be trained include:
 - Entrants (*workers*)
 - Attendants
 - Entry supervisors
 - Rescue team members

Evaluation

Activity 4: Confined Spaces

1. How important is this activity for you and your co-workers?

Please circle one number.

Activity Is Not Important			Activity Is Very Important	
1	2	3	4	5

2. Please **put an “X”** by the **one factsheet** you feel is the most important.

1. Setting Priorities: Life Comes First	6. Atmospheric Hazards: Toxic Gases
2. Alert, Think, Then Act: Emergency Response Procedures	7. Non-Permit and Permit Required Confined Spaces and Procedures
3. What Is a Confined Space?	8. Contractors and Confined Spaces
4. Hazards of Confined Space Work	9. OSHA Requires Training For Confined Spaces
5. Atmospheric Hazards: Too Much or Too Little Oxygen	10. Recommendations for Safe Entry: A Checklist

3. Which summary point do you feel is most important?

Please circle one number.

Most Important Summary Point				
1.	2.	3.	4.	5.
6.	7.	8.	9.	

4. What would you suggest be done to improve this Activity?

Activity 5: Evaluating the Training

Purpose

To evaluate this health and safety training and to spend some time talking about where we go from here.

This Activity has one task.

3. How would you rate the workbook's readability?

Too hard

Just right

Too easy

4. What health and safety topics would you like to learn more about?

5. Of all the activities, which was your favorite? Why?

Appendix: Chemical Protective Gloves

The table below is from the U.S. Department of Energy's *Occupational Safety and Health Technical Reference Manual*. It rates various gloves as being protective against specific chemicals and can help you select the most appropriate gloves for the jobs you work on that involve working with or around dangerous chemicals. The ratings are abbreviated as follows: **VG**: Very Good; **G**: Good; **F**: Fair; **P**: Poor (not recommended). Chemicals marked with an asterisk (*) are for limited service.

Chemical	Neoprene Latex/Rubber	Butyl	Nitrile
Acetaldehyde*	VG	G	VG
Acetic acid	VG	VG	VG
Acetone*	G	VG	VG
Ammonium hydroxide	VG	VG	VG
Amy acetate*	F	P	F
Aniline	G	F	F
Benzaldehyde*	F	F	G
Benzene*	P	P	P
Butyl acetate	G	F	F
Butyl alcohol	VG	VG	VG
Carbon disulfide	F	F	F
Carbon tetrachloride*	F	P	P
Castor oil	F	P	F
Chlorobenzene*	F	P	F
Chloroform*	G	P	P
Chloronaphthalene	F	P	F
Chromic acid (50%)	F	P	F
Citric acid (10%)	VG	VG	VG
Cyclohexanol	G	F	G
Dibutyl phthalate*	G	P	G
Diesel fuel	G	P	P
Diisobutyl ketone	P	F	G
Dimethylformamide	F	F	G
Diocetyl phthalate	G	P	F
Dioxane	VG	G	G

(continued)

Protective Gloves Chart (continued)

Epoxy resins, dry	VG	VG	VG	VG
Ethyl acetate*	G	F	G	F
Ethyl alcohol	VG	VG	VG	VG
Ethyl ether*	VG	G	VG	G
Ethylene dichloride*	F	P	F	P
Ethylene glycol	VG	VG	VG	VG
Formaldehyde	VG	VG	VG	VG
Formic acid	VG	VG	VG	VG
Freon 11	G	P	F	G
Freon 12	G	P	F	G
Freon 21	G	P	F	G
Freon 22	G	P	F	G
Furfural*	G	G	G	G
Gasoline, leaded	G	P	F	VG
Gasoline, unleaded	G	P	F	VG
Glycerin	VG	VG	VG	VG
Hexane	F	P	P	G
Hydrazine (65%)	F	G	G	G
Hydrochloric acid	VG	G	G	G
Hydrofluoric acid (48%)	VG	G	G	G
Hydrogen peroxide (30%)	G	G	G	G
Hydroquinone	G	G	G	F
Isooctane	F	P	P	VG
Kerosene	VG	F	F	VG
Ketones	G	VG	VG	P
Lacquer thinners	G	F	F	P
Lactic acid (85%)	VG	VG	VG	VG
Lauric acid (36%)	VG	F	VG	VG
Lineolic acid	VG	P	F	G
Linseed oil	VG	P	F	VG
Maleic acid	VG	VG	VG	VG
Methyl alcohol	VG	VG	VG	VG
Methylamine	F	F	G	G
Methyl bromide	G	F	G	F
Methyl chloride*	P	P	P	P

Methyl ethyl ketone*	G	G	VG	P
Methyl isobutyl ketone*	F	F	VG	P
Methyl methacrylate	G	G	VG	F
Monoethanolamine	VG	G	VG	VG
Morpholine	VG	VG	VG	G
Naphthalene	G	F	F	G
Napthas, aliphatic	VG	F	F	VG
Napthas, aromatic	G	P	P	G
Nitric acid*	G	F	F	F
Nitric acid, red and white fuming	P	P	P	P
Nitromethane (95.5%)*	F	P	F	F
Nitropropane (95.5%)	F	P	F	F
Octyl alcohol	VG	VG	VG	VG
Oleic acid	VG	F	G	VG
Oxalic acid	VG	VG	VG	VG
Palmitic acid	VG	VG	VG	VG
Perchloric acid (60%)	VG	F	G	G
Perchloroethylene	F	P	P	G
Petroleum distillates (naphtha)	G	P	P	VG
Phenol	VG	F	G	F
Phosphoric acid	VG	G	VG	VG
Potassium hydroxide	VG	VG	VG	VG
Propyl acetate	G	F	G	F
Propyl alcohol	VG	VG	VG	VG
Propyl alcohol (iso)	VG	VG	VG	VG
Sodium hydroxide	VG	VG	VG	VG
Styrene	P	P	P	F
Styrene (100%)	P	P	P	F
Sulfuric acid	G	G	G	G
Tannic acid (65)	VG	VG	VG	VG
Tetrahydrofuran	P	F	F	F
Toluene*	F	P	P	F
Toluene diisocyanate (TDI)	F	G	G	F

(continued)

Protective Gloves Chart (continued)

Trichloroethylene*	F	F	P	G
Triethanolamine (85%)	VG	G	G	VG
Tung oil	VG	P	F	VG
Turpentine	G	F	F	VG
Xylene*	P	P	P	F

Note: When selecting chemical-resistant gloves be sure to consult the manufacturer's recommendations, especially if the gloved hand(s) will be immersed in the chemical.

Protective gloves should be inspected before each use to ensure that they are not torn, punctured, or defective in any way. A visual inspection will help detect cuts or tears. Gloves that are discolored or stiff may be defective because of excessive use or degradation from chemical exposures (see the PPE Activity for more information on degradation).

Reuse of chemical-resistant gloves should be evaluated carefully. A decision to reuse chemically-exposed gloves should take into consideration the toxicity of the chemicals involved, the duration of the exposure, storage and temperature.

