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# Hazardous Materials I

## Primary Knowledge Instructor Guide

### Note to Instructor

Hazardous Materials I is the first primary knowledge (PK) unit in the Hazardous Materials Learning Module. It is recommended that Hazardous Materials II be covered after Hazardous Materials I. A Knowledge Probe (KP) is included in this learning module. The KP allows you to pre-test the participants to determine the amount of knowledge they may already have relative to hazardous materials.

Below is the *Hazardous Material Learning Module*:

- Hazardous Materials I and II Knowledge Probe (pre-test)
- **Hazardous Materials I**
- Hazardous Materials II
- Hazardous Materials I and II Activity
- Hazardous Materials I and II Final Assessment

A PowerPoint presentation is provided for a classroom presentation. The PowerPoint is a summary of the PG. SCME offers four other safety learning modules as well as other learning modules related to microtechnology. To download these modules please visit the SCME website (<http://scme-nm.org>).

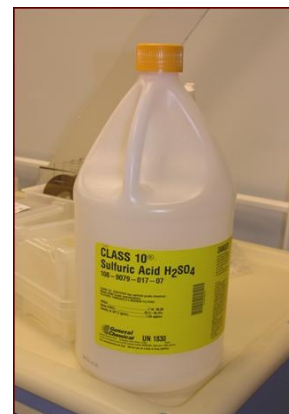
## Description and Estimated Time

This purpose of this learning module is to provide information on hazardous materials and how these materials could affect one's health and the safety of the working environment. This information should provide students and employees with the knowledge and confidence needed to work in environments in which hazardous materials are used and stored.

This unit provides some of the content information needed to safely work with and around hazardous materials. Hazardous Materials (HazMat) I provides information on the federal regulations for HazMat training and discusses the characteristics of chemicals that create physical hazards such as explosions and violent reactions.

Hazardous Materials II covers the characteristics of chemicals that are considered health hazards. It also covers how chemicals can enter the body and what one can do to prevent toxic exposure. Both of these units should be studied prior to working in a micro-fabrication facility.

The information presented is brief. Allow at least 10 - 15 minutes.



*Hazardous Chemical*

HazMat I provides an introduction to OSHA (Occupational Safety and Health Association) regulations and some of the terminology and symbols associated with hazardous materials, specifically physical hazards.



It should precede all activities in which one is required to handle, work with or around chemicals.

## Introduction

According to the U.S. Department of Labor, Occupational Safety and Health Administration (OSHA),

- 32 million Americans work with chemicals and
- there are approximately 650,000 chemicals in the workplace.

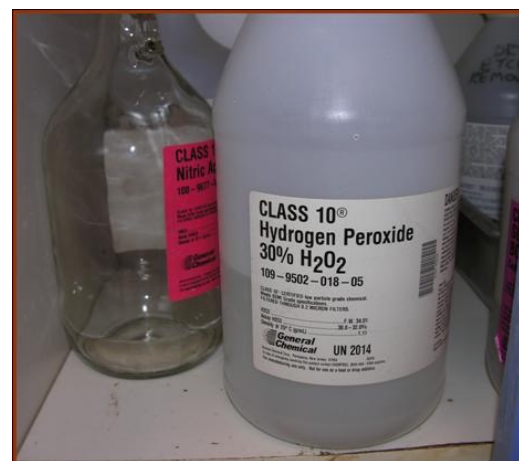
Companies that manufacture MEMS (microelectromechanical systems) are heavily dependent upon chemicals in their processes. Such chemicals include hydrogen peroxide, sulfuric acid, ammonia, and potassium hydroxide, just to name a few. An understanding of the hazards associated with all chemicals is a requirement of ALL employees. It is also the responsibility and right of every employee to know these hazards and understand their right to request that their employer adhere to all safety and OSHA requirements.



## Why is this information important?

One of the requirements of the OSHA Hazard Communication Standard (HCS) [29CFR 1910.1200] requires employers to provide training for all employees on how to locate information on specific chemicals (Material Safety Data Sheets – MSDS), how to interpret MSDS's and how to interpret chemical labels.

The OSHA Lab Standard [29CFR 1910.1450] applies to all laboratories that use hazardous chemicals in accordance with the definition of laboratory use and scale. Where this standard applies, it supersedes some of the provisions in the HCS.



*Chemical Label Information*

## **What Everyone Should Know**

All chemicals are required to have labels with specific information on the chemical label. In addition, all chemicals require a Material Safety Data Sheet (MSDS) and a MSDS must be accessible to employees for ALL of the chemicals in a facility.

In order to effectively interpret a MSDS and chemical label, you must understand several things:

- Terminology associated with chemicals
- Health and physical hazards of chemicals
- Characteristics of various chemicals
- Rules to apply when working with and around chemicals.

In order to be safe when working with or around hazardous chemicals there are a few things that you need to know and that your employer needs to provide.

- You need to know exactly what chemicals you are working with and around and the potential hazards of those chemicals.
- You need to know how to prevent accidents from occurring, but also what to do if an accident does occur.
- Your employer must provide easy access to information about the chemicals in the facility and provide you with the training necessary for you to effectively interpret and apply that information.

## **Learning Module Objectives**

- Describe at least five characteristics of chemicals that are physical hazards.
- Describe at last five characteristics of chemicals that are considered health hazards.
- Match the physical and health hazards to their warning symbols.

## OSHA (Occupational Safety and Health Administration) Facts

### OSHA FACTS<sup>1</sup>

- Over 30 million Americans work with chemicals.
- Approximately 650,000 chemicals are in the workplace today and this number is constantly increasing.
- Exposure to certain chemicals may cause or contribute to health problems.
- Many chemicals present safety hazards from fire and explosions.

### OSHA Statistics - Worker Injuries/Illnesses/Fatalities<sup>2</sup>

- 4.0 million injuries and illnesses among private sector firms in 2013 (down from 4.4 million in 2003)
- 30 percent of work-related injuries occurred in goods-producing industries
- 70 percent of work-related injuries occurred in service industries
- 4,405 workers died in 2013, down from 5,488 worker deaths in 2007

## OSHA Hazardous Communications Standard

OSHA Hazardous Communications Standard (29 CFR 1910.1200). The OSHA Hazard Communication Standard (HCS) defines a hazardous chemical as *any chemical which is a physical hazard or health hazard*.

OSHA's Hazard Communications Standard guarantees all employees **the right to know** the dangers of the hazardous chemicals they work with and requires that all employees be trained to protect themselves and their coworkers against these dangers.



*Training for All Employees*

## **Standard Requirements**

The Hazardous Communications Standard guarantees an employee's "right to know" and mandates training for all employees. It requires employers to provide employees with the following:

- List of all chemicals in the workplace
- Hazard evaluation by the manufacturer
- Product warning label system
- Accessible MSDS's for all chemicals
- Written hazard communications program
- Training program
- Procedures to maintain and evaluate the program

## HazMat I

The following information and the information in HazMat II will help you better understand the information and the terminology that you find on chemical labels and in MSDSs.

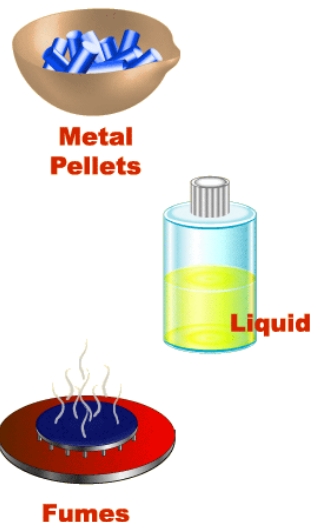
### Physical Forms of Chemicals

Chemicals can be in any of these forms:

- Liquids
- Solids
- Gases
- Vapors
- Fumes
- Mists
- Fibers
- Dust

Some chemicals are generated in the workplace through daily operations. Examples of such chemicals include the following:

- Welding fumes
- Dusts
- Exhaust fumes
- Process by-products



*What are two chemicals that are generated in a microtechnology fabrication facility?*

### Atmospheric Hazards

Atmospheric hazards include fumes, gases, dusts, and mists. In many cases, these hazards are toxic or corrosive, or can be created by the mixing of two normally non-volatile products. For example, Hydrochloric gas is produced when water is used to clean machine parts that have been exposed to a chlorinated by-product. In addition, the fumes of some solvents are highly flammable.

*What are two other atmospheric hazards that one might find in a manufacturing environment?*

## Physical vs. Health Hazards

Chemicals exhibit various characteristics. These characteristics are used to help identify the physical and health hazard of a chemical.

*Physical hazards* are associated with any chemical that produces a violent change when subjected to external factors such as heat, vibration, or oxygen, or in some cases, standard temperature and pressure (0 °C and 100 kPa (1 bar)). Flammables, explosives, and radioactive chemicals produce a violent change under certain conditions.

*Health Hazards* are associated with any chemical that, under certain conditions, produces acute or chronic health effects to humans through exposure. Carcinogens, poisons, and irritants all carry warnings of potential health hazards. (*SCME Hazardous Materials II discusses health hazards of chemicals.*)

## Physical Hazards of Chemicals

Physical hazards are associated with any of the following chemical characteristics:

*Combustible* – Generally, any liquid or solid that will burn. OSHA defines a combustible as any liquid that burns when heated to 100 degrees F (37.8 C) or higher.

*Explosive* - Substance that explodes if heated or subjected to an electric spark. An explosive can release dangerous gases and continue to feed a fire.

*Flammable* - Substance that can easily be set on fire and once set, continues to fuel the fire. A liquid, as well as its vapor, can be flammable.

*Oxidizer* - Chemical that reacts with oxygen. This reaction aids in maintaining a fire once started.

*Peroxide* - Substance that is unstable, releases oxygen when heated, and is a powerful oxidizing agent. Peroxides may be formed directly by the reaction of an element or compound with oxygen.

*Pyrophoric* - Substance that can be spontaneously ignited in air.

*Radioactive* - Chemical that emits radiation due to a chemical reaction.

*Reactivity* - The relative capacity of a chemical to combine chemically or react with another substance.



Which of the following chemical characteristics is NOT considered a physical hazard?

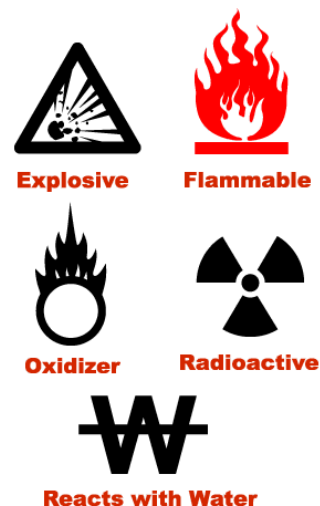
1. Oxidizer
2. Explosive
3. Carcinogen
4. Flammable

*Answer: Carcinogen is a health hazard. The others are physical hazards.*

### Physical Hazard Warnings

These are universal symbols that are used to quickly warn of potential physical hazards. These symbols can be found on chemical labels, compressed gas bottles, facility doors, chemical storage units, and on any object that contains a hazardous material.

*It is important that you become familiar with these symbols so that you can recognize them immediately.*



What physical hazard is represented by this symbol?



*Answer: This symbol says that the chemical is reactive with water; therefore, do not mix with water.*

What physical hazard is represented by this symbol?



*Answer: This symbol indicates that the chemical is radioactive (emits radiation)*

## Summary

In order to understand the information presented in MSDS's and on chemical labels, one must know and understand the

- terminology associated with hazardous materials and
- hazard warnings associated with chemicals.

To learn about the *Health Hazards* of chemicals, read the next unit – Hazardous Materials II.

## Short Activity for Hazardous Materials I

The differences between certain physical hazards can be confusing. For example, can you quickly state the differences between a combustible and an explosive?

To help identify the characteristics that establish a chemical as a specific physical hazard in a fashion that YOU understand, complete the following assignment.

*Develop a system (e.g., chart, table, graphic) that will allow you to distinguish between combustibles, flammables, explosive, oxidizers, and pyrophorics.*

## References

1. Hazard Communication in the 21<sup>st</sup> Century Workplace. March 2004. Executive Summary. OSHA.gov. <http://www.osha.gov/dsg/hazcom/finalmsdsreport.html>
2. Injuries, Illnesses, and Fatalities. Bureau of Labor Statistics. <http://www.bls.gov/iif/>
3. OSHA ([www.osha.gov](http://www.osha.gov))
4. OSHA Hazardous Communications Standards (<http://www.osha.gov/SLTC/hazardcommunications/index.html>)
5. The MSDS HyperGlossary (<http://www.ilpi.com/msds/ref/index.html>)
6. OSU Online Safety Library (<http://www.pp.okstate.edu/ehs/Hazmat.htm>)

## **Related SCME Units and Learning Modules**

- Hazardous Materials II
- Hazardous Materials I and II Activity
- Chemical Lab Safety Rules
- Material Safety Data Sheets Learning Module
- Chemical Labels Learning Module

## **Disclaimer**

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