LABORATORY SAFETY COURSE

CONTINUING EDUCATION
PROFESSIONAL DEVELOPMENT COURSE

Technical Learning College

Printing and Saving Instructions

TLC recommends that you download and save this pdf document and assignment to your computer desktop and open it with Adobe Acrobat DC reader.

Adobe Acrobat DC reader is a free computer software program and you can find it at Adobe Acrobat's website.

You can complete the course by viewing the course on your computer or you can print it out. This course booklet does not have the assignment (the test). Please visit our website and download the assignment (the test).

Printing Instructions: Once you have purchased the program, we will give you permission to print this document. If you are going to print this document, it was designed to be printed double-sided or duplexed but can be printed single-sided.

Internet Link to Assignment…
http://www.abctlc.com/downloads/PDF/Lab%20Safety%20ASSIGNMENT.pdf

State Approval Listing Link, check to see if your State accepts or has pre-approved this course. Not all States are listed. Not all courses are listed. Do not solely trust our list for it may be outdated. It is your sole responsibility to ensure this course is accepted for credit. No refunds.

State Approval Listing URL…
http://www.abctlc.com/downloads/PDF/CEU%20State%20Approvals.pdf

You can obtain a printed version from TLC for an additional $129.95 plus shipping charges.

All downloads are electronically tracked and monitored for security purposes.

Library of Congress Card Number 6582762
ISBN 978-0-9799559-4-5

Some States and many employers require the final exam to be proctored.

Do not solely depend on TLC's Approval list for it may be outdated.

A second certificate of completion for a second State Agency $50 processing fee.

Most of our students prefer to do the assignment in Word and e-mail or fax the assignment back to us. We also teach this course in a conventional hands-on class. Call us and schedule a class today.

Responsibility

This course contains EPA's federal rule requirements. Please be aware that each state implements drinking water/wastewater/safety regulations may be more stringent than EPA's or OSHA's regulations. Check with your state environmental agency for more information. You are solely responsible in ensuring that you abide with your jurisdiction or agency's rules and regulations.

Copyright Notice

Contributing Editors

James L. Six Received a Bachelor of Science Degree in Civil Engineering from the University of Akron in June of 1976, Registered Professional Engineer in the State of Ohio, Number 45031 (Retired), Class IV Water Supply Operator issued by Ohio EPA, Number WS4-1012914-08, Class II Wastewater Collection System Operator issued by Ohio EPA, Number WC2-1012914-94

Joseph Camerata has a BS in Management with honors (magna cum laude). He retired as a Chemist in 2006 having worked in the field of chemical, environmental, and industrial hygiene sampling and analysis for 40 years. He has been a professional presenter at an EPA analytical conference at the Biosphere in Arizona and a presenter at an AWWA conference in Mesa, Arizona. He also taught safety classes at the Honeywell and City of Phoenix, and is a motivational/inspirational speaker nationally and internationally.

James Bevan, Water Quality Inspector S.M.E. Twenty years of experience in the environmental field dealing with all aspects of water regulations on the federal, state, and local levels. Experience in the water/wastewater industry includes operation of a wastewater facility, industrial pretreatment program compliance sampling, cross-connection control program management, storm water management, industrial and commercial facility inspections, writing inspection reports for industry, and technical reports per EPA permit requirements. Teacher and Proctor in Charge for Backflow Certification Testing at the ASETT Center in Tucson for the past 15 years and possess an Arizona Community College, Special Teaching Certificate in Environmental Studies. Extensive knowledge and experience in college course and assignment/assessment writing.

Dr. Pete Greer S.M.E., Retired biology instructor, chemistry and biological review.

Jack White, Environmental, Health, Safety expert, City of Phoenix. Art Credits.

Today's labs will have several areas that can present a safety hazard.

Required Safety Training

(i) Employee training shall include:
(A) Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);
(B) The physical and health hazards of chemicals in the work area; and
(C) The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.
(ii) The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.
(g) Medical consultation and medical examinations. (1) The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary.

Use of hood: Use the hood for operations which might result in release of toxic chemical vapors or dust.

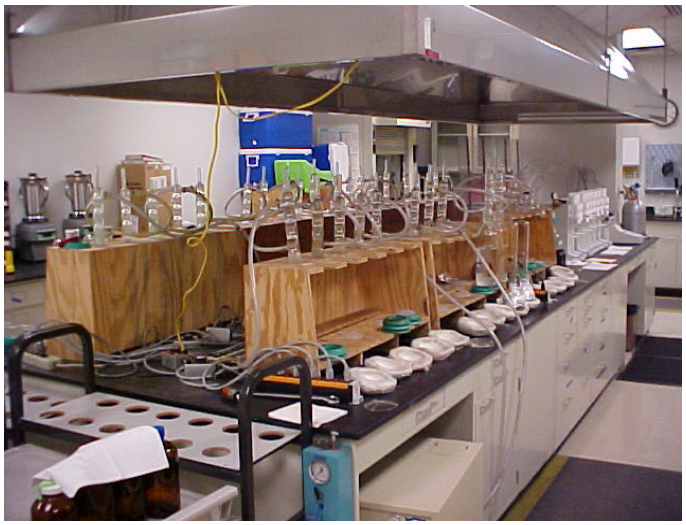
As a rule of thumb, use a hood or other local ventilation device when working with any appreciably volatile substance with a TLV of less than 50 ppm.

Confirm adequate hood performance before use; keep hood closed at all times except when adjustments within the hood are being made; keep materials stored in hoods to a minimum and do not allow them to block vents or air flow.

Leave the hood "**on**" when it is not in active use if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "**off**".

Vigilance: Be alert to unsafe conditions and see that they are corrected when detected.
Waste disposal: Assure that the plan for each laboratory operation includes plans and training for waste disposal.

Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan.



Ventilation -- (a) General laboratory ventilation. This system should: Provide a source of air for breathing and for input to local ventilation devices; it should not be relied on for protection from toxic substances released into the laboratory; ensure that laboratory air is continually replaced, preventing increase of air concentrations of toxic substances during the working day; direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building.

Hoods. A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 workers if they spend most of their time working with chemicals; each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use. If this is not possible, work with substances of unknown toxicity should be avoided or other types of local ventilation devices should be provided.

Technical Learning College's Scope and Function

Welcome to the Program,

Technical Learning College (TLC) offers affordable continuing education for today's working professionals who need to maintain licenses or certifications. TLC holds several different governmental agency approvals for granting of continuing education credit.

TLC's delivery method of continuing education can include traditional types of classroom lectures and distance-based courses or independent study. TLC's distance based or independent study courses are offered in a print - based distance educational format. We will beat any other training competitor's price for the same CEU material or classroom training.

Our courses are designed to be flexible and for you do finish the material on your leisure. Students can also receive course materials through the mail. The CEU course or e-manual will contain all your lessons, activities and instruction to obtain the assignments. All of TLC's CEU courses allow students to submit assignments using e-mail or fax, or by postal mail. (See the course description for more information.)

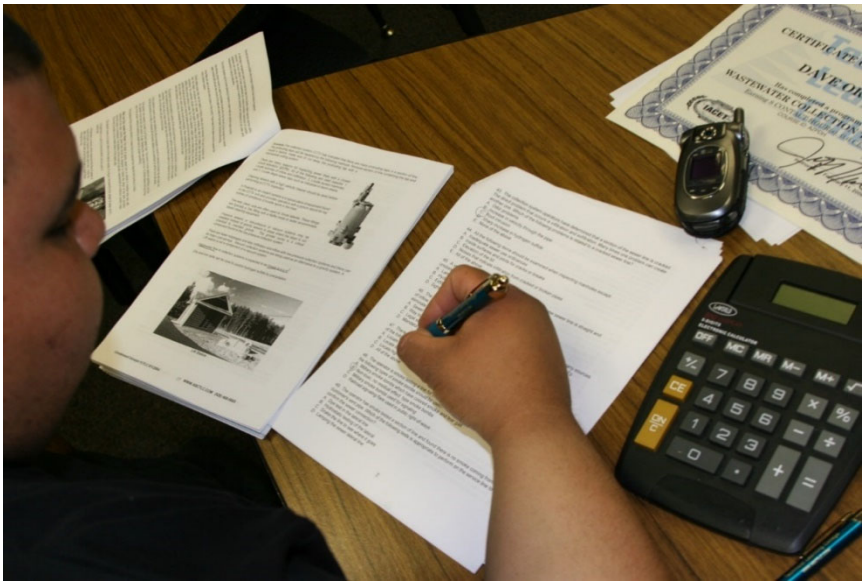
Students have direct contact with their instructor—primarily by e-mail or telephone. TLC's CEU courses may use such technologies as the World Wide Web, e-mail, CD-ROMs, videotapes and hard copies. (See the course description.) Make sure you have access to the necessary equipment before enrolling, i.e., printer, Microsoft Word and/or Adobe Acrobat Reader. Some courses may require proctored closed-book exams depending upon your state or employer requirements.

Flexible Learning
At TLC, there are no scheduled online sessions or passwords you need contend with, nor are you required to participate in learning teams or groups designed for the "typical" younger campus based student. You can work at your own pace, completing assignments in time-frames that work best for you. TLC's method of flexible individualized instruction is designed to provide each student the guidance and support needed for successful course completion.

Course Structure
TLC's online courses combine the best of online delivery and traditional university textbooks. You can easily find the course syllabus, course content, assignments, and the post-exam (Assignment). This student friendly course design allows you the most flexibility in choosing when and where you will study.

Classroom of One
TLC offers you the best of both worlds. You learn on your own terms, on your own time, but you are never on your own. Once enrolled, you will be assigned a personal Student Service Representative who works with you on an individualized basis throughout your program of study. Course specific faculty members (S.M.E.) are assigned at the beginning of each course providing the academic support you need to successfully complete each course. Please call or email us for assistance.

Satisfaction Guaranteed
We have many years of experience, dealing with thousands of students. We assure you, our customer satisfaction is second to none. This is one reason we have taught more than 20,000 students.



We welcome you to do the electronic version of the assignment and submit the answer key and registration to us either by fax or e-mail. If you need this assignment graded and a certificate of completion within a 48-hour turn around, prepare to pay an additional rush charge of $50.

We welcome you to complete the assignment in Word.

Once we grade it, we will mail a certificate of completion to you. Call us if you need any help.

Contact Numbers

Fax (928) 468-0675
Email Info@tlch2o.com
Telephone (866) 557-1746

CEU Course Description

Laboratory Safety CEU Training Course
The basic goal of a Laboratory Safety and Chemical Hygiene Program is to make sure employers and employees know about potential work hazards, how to recognize them and, most importantly, how to protect themselves. This course is designed to help reduce the possible incidence of chemical source illness and injuries.

Audience
Laboratory Analsis and personnel, Water Distribution, Water Treatment Operators, Wastewater Operators and Industrial/Pretreatment Operators. The target audience for this course is the person interested in working in a chemical/biological laboratory or a water treatment/wastewater treatment facility and/or wishing to maintain CEUs for a certification license or to learn how to do the job safely and effectively, and/or to meet education needs for promotion. This short CEU course will cover general laboratory safety procedures and the federal laboratory safety rules.

Where are the Regulations? (***In rear of this manual***)
The Occupational Safety and Health Administration (**OSHA**) has issued a regulation to help control chemical exposure on the job. The regulation is called the Occupational exposure to hazardous chemicals in laboratories. It can be found in the Code of Federal Regulations, at 29 CFR § 1910.1450. The Standard says you have a right to know what chemicals you are working with, or around. Its intention is to make your workplace a safer place. So it's important that you have some basic understanding of these Standards and the rights it grants you.

The Laboratory Safety, Chemical Hygiene and Hazard Communication Standards requires that all chemicals in your workplace be fully evaluated for possible physical or health hazards. And, it mandates that all information relating to these hazards be available to you.

Course Procedures for Registration and Support
All of Technical Learning College's correspondence courses have complete registration and support services offered. Delivery of services will include, e-mail, web site, telephone, fax and mail support. TLC will attempt immediate and prompt service.

When a student registers for a distance or correspondence course, he/she is assigned a start date and an end date. It is the student's responsibility to note dates for assignments and keep up with the course work. If a student falls behind, he/she must contact TLC and request an end date extension in order to complete the course. It is the prerogative of TLC to decide whether to grant the request. All students will be tracked by unique number assigned to the student.

Instructions for Written Assignments
The Laboratory Safety correspondence course will be a True/False type of an exam. TLC will require that the document is typed and preferably e-mailed to TLC. You can find the assignment and complete course support under the Assignment Page, www.abctlc.com.

Feedback Mechanism (Examination Procedures)
Each student will receive a feedback form as part of their study packet. You will be able to find this form in the front of the course or lesson.

Security and Integrity
All students are required to do their own work. All lesson sheets and final exams are not returned to the student to discourage sharing of answers. Any fraud or deceit and the student will forfeit all fees and the appropriate agency will be notified.

Required Texts
The Laboratory Safety course does not require any course materials. This course is complete.

Recordkeeping and Reporting Practices
TLC will keep all student records for a minimum of seven years. It is the student's responsibility to give the completion certificate to the appropriate agencies.

ADA Compliance
TLC will make reasonable accommodations for persons with documented disabilities. Students should notify TLC and their instructors of any special needs. Course content may vary from this outline to meet the needs of this particular group.

Educational Mission

The educational mission of TLC is:

To provide TLC students with comprehensive and ongoing training in the theory and skills needed for the environmental education field,

To provide TLC students opportunities to apply and understand the theory and skills needed for operator certification,

To provide opportunities for TLC students to learn and practice environmental educational skills with members of the community for the purpose of sharing diverse perspectives and experience,

To provide a forum in which students can exchange experiences and ideas related to environmental education,

To provide a forum for the collection and dissemination of current information related to environmental education, and to maintain an environment that nurtures academic and personal growth.

TABLE OF CONTENTS

Important Information about this Manual

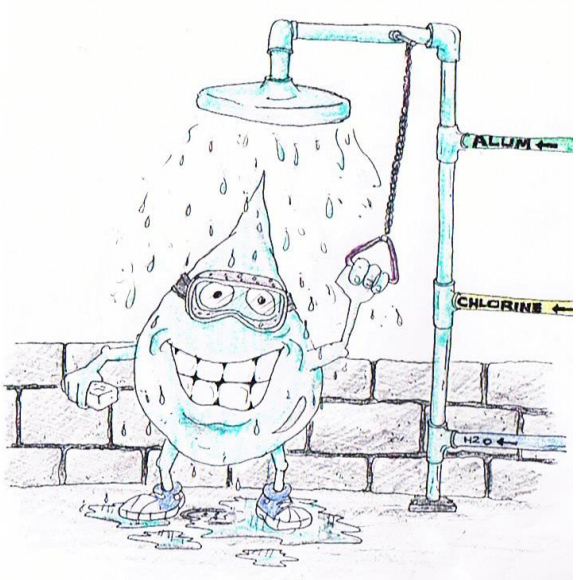
This manual has been prepared to assist employees in the general awareness of the occupational exposure to hazardous chemicals in laboratories and dealing with often-complex procedures and requirements for safely handling hazardous and toxic materials. The scope of the material is quite large, requiring a major effort to bring it under control. Employee health and safety, as well as that of the public, depend upon careful application of federal and state regulations and safe working procedures.

This manual will cover general laws, regulations, required procedures and work rules relating to the occupational exposure to hazardous chemicals in laboratories. It should be noted, however, that the federal and state regulations is an ongoing process and subject to change over time. For this reason, a list of resources and hyperlinks is provided to assist in obtaining the most up-to-date information on various subjects. This manual is a guidance document for employees who are involved with the Occupational exposure to hazardous chemicals in laboratories. It is not designed to meet the full requirements of the United States Environmental Protection Agency (**EPA**) or the Department of Labor-Occupational Safety and Health Administration (**OSHA**) rules and regulations.

This course manual will provide general laboratory safety guidance and should not be used as a preliminary basis for developing a general safety plan, or a plan to prevent the occupational exposure to hazardous chemicals. This document does not detail the occupational exposure to hazardous chemicals or is a laboratory textbook or a comprehensive source book on the occupational exposure to hazardous chemicals in laboratories regulations or settings.

Technical Learning College makes no warranty, guarantee or representation as to the absolute correctness or appropriateness of the information in this manual and assumes no responsibility in connection with the implementation of this information. It cannot be assumed that this manual contains all measures and concepts required for specific conditions or circumstances.

This document should be used for guidance and is not considered a legal document. Individuals who are responsible for the occupational exposure to hazardous chemicals in laboratories and the health and safety of workers at hazardous waste sites should obtain and comply with the most recent federal, state, and local regulations relevant to these sites and are urged to consult with OSHA, the EPA and other appropriate federal, state and local agencies.



Example of an Enclosed Lab

Laboratory use of hazardous chemicals means handling or use of such chemicals in which all of the following conditions are met:

(i) Chemical manipulations are carried out on a "**laboratory scale**;"

(ii) Multiple chemical procedures or chemicals are used;

(iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and

(iv) "**Protective laboratory practices and equipment**" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

Use of respirators. Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of 29 CFR 1910.134.

Recordkeeping. (1) The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by this standard.

Laboratory Safety Introduction

OSHA's Occupational Exposure to Hazardous Chemicals in Laboratories standard (29 CFR 1910.1450) addresses the unique features of laboratory work

- Laboratories use a greater variety of hazardous substances than the typical industrial workplace, but in smaller quantities. OSHA defines "laboratory scale" operations as those that use containers designed to be easily and safely manipulated by one person.
- Substances and procedures used tend to change frequently and unpredictably.
- Workers and supervisors are usually highly trained and educated about the substances.

All laboratory personnel should be informed of the contents of "Occupational Exposure to Hazardous Chemicals in Laboratories," OSHA Standard 29 CFR 1910.1450, and the location and contents of your employer's Chemical Hygiene Plan.

All laboratory personnel will be informed of the OSHA Permissible Exposure Limits (PELs) and ACGIH Threshold Limit Values (TLVs). A listing of OSHA PELs is located in Appendix B.

Training

Your training will consist of methods and observations that may be used to detect the presence or release of a hazardous chemical, the physical and health hazardous of chemicals in the work area, the measures employees can take to protect themselves from exposure, including engineering controls, personal protective equipment, work practices, and emergency procedures.

Your training should also cover your employer's Chemical Hygiene Plan and Hazardous Waste Management Procedures.

A normal day for a Lab Tech will include the washing of lab glassware. Sometimes the Tech will use acid to wash certain glass bottles. Notice the broken glass or Sharps container.

Clearly marked and different types of hazardous waste disposal containers need to be present in your lab.

Common terms used in this course.

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

Health Hazard
The term "**health hazard**" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Employee
Is an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

Employees' Right to Know

Employers must train workers about:

- Hazards in the lab, including criteria for too much chemical exposure.
- Protective clothing and equipment and how to use them.
- Emergency procedures.
- Detailed safety information about chemicals in Safety Data Sheets (SDS) formerly material safety data sheets (MSDS).
- Free medical consultation/treatment in case of overexposure to hazardous chemicals.

Permissible Exposure Limits and Exposure Determination

Employees of laboratories using OSHA-regulated substances cannot be exposed to these substances beyond the OSHA permissible exposure limits. Employers are required to measure employees' exposure to any regulated substances if that substance is required by a standard for monitoring. Employers must also inform employees of the monitoring results.

Safety Precautions

Caution and common sense prevent safety problems:

- Assume that any unfamiliar chemical is hazardous.
- Read the label and SDS for important safety information before working with any chemical.
- Consider a mixture to be at least as hazardous as its most hazardous component.
- Never use anything that is not labeled.
- Never combine substances unless instructed to do so. They might react with one another, causing an explosion or release of harmful vapors. Don't add a chemical to a container that isn't clean and empty.
- Follow all safety procedures to the letter.
- In case of chemical overexposure, get medical attention, inform the supervisor, and check the SDS for first-aid information.
- Report any spill. Don't attempt to contain or clean up the spill **UNLESS** trained and equipped to do so.

Fish tanks are common where water or wastewater treatment is being used.
Fish are a great detector/ indicator to chemical contention.

Required Information

Employees shall be informed of:

(i) The contents of this standard and its appendices which shall be made available to employees;

(ii) The location and availability of the employer's Chemical Hygiene Plan;

(iii) The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;

(iv) Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

(v) The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Material Safety Data Sheets received from the chemical supplier.

Notice the anti-slip mat and the several different types of gloves necessary to handle the different chemicals that could be present. Notice how each bottle and drawer is clearly marked.

The Chemical Hygiene Plan (CHP)

Like the written hazard communication plan, the CHP covers procedures for protecting employees from hazards and keeping exposures below permissible limits. But it's more flexible so as to allow labs to adopt procedures for their individual needs. ***Any CHP must include***:

- Standard operating procedures for lab work using hazardous substances.
- How the company will determine and reduce employee exposure to hazardous substances, examples, engineering controls, personal protective equipment, and hygiene practices.
- Measures to ensure that fume hoods and other protective equipment function properly.
- How the company will inform employees about potential health hazards and train them to protect themselves.
- Circumstances in which a particular operation, procedure, or activity will have to be pre-approved by the company.
- Provisions for medical consultation and medical examinations.
- Designation of personnel responsible for implementation of the CHP.
- Provisions for additional employee protection for work with particularly hazardous substances.

Personal Protective Equipment

Always use assigned PPE and make sure it's in good condition. Types of PPE include goggles or side shield safety glasses; gloves; long sleeves; lab coats, aprons, coveralls; sturdy shoes; and respirators. Contact lenses could trap vapors-check with a safety director before wearing them.

Lab Equipment

- Glassware can break, causing chemical contact or cuts:
- Use the right type of glass for the task.
- Discard chipped or cracked glassware.
- Don't use force on glassware.

Autoclaves and other heating equipment:

- Use tongs or heat-resistant gloves.

Electrical equipment creates electric shock hazard:

- Don't touch with wet hands or while standing on a wet floor.
- Report any incidents of shock.
- Don't attempt repairs unless you've been trained.

Centrifuges and other equipment with moving parts can catch or open suddenly:

- Keep clothing and long hair away from equipment.
- Make sure the load is balanced, top is locked, and movement has stopped before opening. Compressed gas cylinders can explode or cause a fire; keep clean and chained in place.

Fire and Burn Hazards

Guidelines for safe work practices:

- Be cautious and follow rules for open flames, reactive substances, and flammables.
- Wear gloves when handling hot glass or tools.
- Keep water and wet hands away from electrical equipment.
- Don't use electrical equipment with worn cords, damaged plugs, etc.

Emergency Preparedness

- Don't work alone in the lab.
- Post emergency phone numbers.
- Keep SDSs on hand-and read them.
- Know what to do in an emergency.
- Know the location of showers, eyewash stations, fire extinguishers.

Know which type of fire extinguisher to use for the chemicals with which you are working. Consult organization procedures, SDSs, and your supervisor.

Work closely with your emergency services and practice annual drills with these agencies. It may be required by OSHA or EPA depending upon your chemical or biological storage at your facility. Don't risk a tragedy or a violation. It is bad press and a lot of red tape.

Summary

- Remember that safety is the first priority in the lab!
- Read and understand the Chemical Hygiene Plan (CHP).
- Learn about the hazards of the chemicals you use.
- Take your time and concentrate on your work.
- Avoid contact with hazardous chemicals.
- Assume that unknown chemicals are hazardous.
- Follow all warning signs and instructions.
- Use the correct PPE.
- Follow all instructions for proper equipment operation.

Chemical Hygiene Plan Introduction

The purpose of this Chemical Hygiene Plan is to define work practices and procedures to help ensure that faculty, staff, students, workers, and the environment are protected from hazards associated with the handling, storage, and use of chemicals in laboratories.

Occupational Safety and Health Administration (**OSHA**) Regulations (29 CFR 1900.1450) require all employers engaged in the laboratory use of hazardous chemicals to develop and carry out the provisions of a Chemical Hygiene Plan that is capable of protecting employees from health hazards associated with hazardous chemicals and capable of keeping exposures below Permissible Exposure Limits (**PELs**).

See Appendix A in the rear of this manual for the full text of **"*Occupational Exposure to Hazardous Chemicals in Laboratories*"**. OSHA defines a laboratory as "**a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis**." Laboratories involve a greater variety of possible hazards than most work places, and some hazards call for precautions not ordinarily encountered. None of the labs at your place of employment are without hazards of some kind and degree.

This Chemical Hygiene Plan applies to all laboratory workers. An example of a laboratory worker would be a university teaching assistant or a faulty member instructing an academic lab. Your employer also has the special responsibility of administering instructional labs with relatively inexperienced students who must be introduced to the safety procedures necessary to conduct various laboratory operations.

A perfect example of an unsafe laboratory, cluttered and without a Chemical Hygiene Plan. An accident is just waiting to happen.

Select Carcinogen means any substance which meets one of the following criteria:

(i) It is regulated by OSHA as a carcinogen; or

(ii) It is listed under the category, "*known to be carcinogens*," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or

(iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or

(iv) It is listed in either Group 2A or 2B by IARC or under the category, "*reasonably anticipated to be carcinogens*" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

(A) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 ug 3 ;

(B) After repeated skin application of less than 300 (ug/kg of body weight) per week; or

(C) After oral dosages of less than 50 ug/kg of body weight per day.

Example of Chemical Hygiene Responsibilities Policy

If you do not have a policy, you need to implement one. Here is an example you can utilize:

Program Coordinator

The Environmental Health and Safety Coordinator or equivalent will serve as the program's coordinator. The Environmental Health and Safety Coordinator will do the following:

- Provide technical assistance to laboratory supervisors and workers concerning appropriate storage, handling, and disposal of hazardous chemicals.
- Remain current on rules and regulations concerning chemicals used in laboratories on campus.
- Conduct Laboratory Safety Surveys (**LSSs**) to assess level of compliance with the CHP.
- Inform new faculty and staff of the information contained in the CHP. Train or coordinate for retraining of Department Chemical Hygiene Officers and Laboratory Supervisors.
- Maintain a library of Safety Data Sheets (**SDSs**) and other laboratory health and safety literature.
- Interact with regulators and agencies, maintain records, and file required reports.
- Oversee and maintain the Chemical Inventory Management System (**ChIM**).

Department Chairperson

Each department chairperson of a science department that uses chemicals will:

- Support the CHP and assist their Department Chemical Hygiene Officer (**DCHO**) or equivalent in maintaining awareness and compliance with the plan.
- Prepare budget requests for health and safety improvements.

List your current department chairpersons here:

Department Chemical Hygiene Officer (DCHO)

Essential to our Chemical Hygiene Plan are Departmental Chemical Hygiene Officers. The following individuals have experience and knowledge of their department's operations and will act as DCHO's for their respective departments. List your current DCHOs here:

The duties and responsibilities of the DCHO are to:

- Coordinate with the departmental faculty and staff in developing and carrying out appropriate laboratory safety, hygiene, and disposal programs specific to their individual departments.
- Maintain and distribute current legal documents for regulated substances used within their department.
- Conduct periodic safety inspections at least once a semester; coordinate for the correction of deficiencies.

Laboratory Supervisors

A laboratory supervisor is anyone overseeing any type of laboratory work. This could include faculty and staff mentors, principal investigators, instructors, and/or other researchers. No one is exempt from the appropriate safety precautions.

Lab supervisors must serve as good role models for their technical staff and students by observing all rules and recommendations, wearing protective equipment, and being enthusiastic about safety.

Laboratory supervisors are responsible for administration of the Chemical Hygiene Plan. Untrained workers (or students) cannot be permitted to work with chemicals. Every laboratory supervisor will ensure that:

- All personnel working in their laboratory(s) are aware of and practice appropriate precautions.
- Rules and Standard Operating Procedures (**SOPs**) are enforced and discipline is maintained.
- Emergency equipment is available and in proper working order and everyone has been trained on its use.
- Information and training on special or unusual hazards or equipment is provided and documented.
- Appropriate safety plans and emergency procedures have been developed and are followed.
- Safety Data Sheets (**SDSs**) are readily accessible and are reviewed before unfamiliar work or work with new chemicals commences.
- Personal protective equipment is available and used.
- All Hazardous Waste Regulations, including waste minimization, are complied with.
- Periodic inspections and surveys of the laboratory work area are conducted.
- Notify the DCHO prior to commencement of any new process or activities covered by this program.

Employees

- Follow all health and safety procedures and rules.
- Report all hazardous conditions to your supervisor immediately.
- Report any job related injury or illnesses to your supervisor and seek treatment as soon as possible.
- Refrain from the operation of any equipment or instruments without proper instruction and authorization.
- Wear or use prescribed personal protective equipment.
- Remain aware of the hazards of **ALL** chemicals in the laboratory and how to handle hazardous chemicals safely.
- Request information and training when unsure about how to handle an unfamiliar or hazardous chemical or procedure.

Chemical Inventory Management Example Policy

Scope
The management and control of chemicals is the responsibility of everyone involved in the acquisition, use, and disposition of them. Your employer has a responsibility to comply with a myriad of federal, state, and local regulations covering chemical purchase, use, transportation, storage, emergency planning, and disposal.

To satisfy this obligation, your employer has implemented a comprehensive Chemical Management System that includes up to date inventories of laboratory chemicals. The following policies and procedures for chemical inventory control are designed to help users understand and meet the above responsibilities and requirements. The procedures cannot be designed to cover every situation.

The system allows for flexibility provided that there is **PRIOR** coordination with the Environmental Health and Safety (**EHS**) Office. All chemical users must comply, and are urged to provide suggestions to assist in continuously improving these procedures.

Objectives
The goals of our system are to:

- Ensure that chemicals are properly identified in the records of your employer and that pertinent health, safety, and other information regarding each item in the inventory is readily available and accessible.
- Facilitate the physical inventory of chemicals through maintenance of a standard numbering system (bar coded tag) and an automated chemical inventory system.
- Minimize waste generation and control waste disposal costs.
- Facilitate budget preparation and planning by maintaining information on usage patterns, age, shelf-life, and cost.
- Minimize the number and amount of chemicals stored throughout the facility.
- Develop accountability procedures to comply with federal, state, and local laws governing purchases, storage, transportation, use, emergency planning, and disposal of the chemicals used at your place of employment.

The benefits of meeting our Chemical Management goals are reduced purchasing and disposal costs, regulatory compliance, and a safe and healthy environment for students, faculty, and staff.

Overview
Your employer has implemented a computerized Chemical Inventory System to provide a perpetual inventory record of all chemicals located in the Division. The components of the system are shown in figure 1. All chemical purchases are made through the EHS Office. Users place chemical orders on a special three-part Chemical Requisition Form.

The form can be mailed or hand carried to the EHS Office. The EHS Coordinator evaluates and approves the chemical order after checking available stock. Next, the requisition form goes to the Purchasing Department and an order is placed with the specified vendor. The vender ships the order to Central Receiving, where it is processed and then delivered. The order is unpacked and checked and a barcode tag is placed on each container greater than 25 g or 25 ml.

Bar code tagging of chemical containers is central to an automated system because all information about a specific chemical container and its contents is keyed to a unique bar code tag number.

The bar code tag number is like a license plate; the number is not coded to contain intelligent data. Rather it is the key pointer in a relational database to other information that relates specifically to that number. The tag number is printed in bar code 39 symbology and human readable format.

Tags are also being applied to rooms, cabinets, and shelves to speed re-inventory. The quantity, user name, location, PO #, vendor, date, and price are some of the information recorded for each chemical container in a database called ChIM (Chemical Inventory Management). Health, safety, and storage information is recorded under the Chemical Abstracts Service (**CAS**) Registry Number.

For more information see your Chemical Management Guide.

The acceptance of gifts is or should ALWAYS be prohibited without the consent of the EHS Coordinator and Department Chemical Hygiene Officer (**DCHO**). Approved gifts must be tagged and entered into the Chemical Inventory System.

Once the initial physical inventory is completed the labs will be re-inventoried on a regular basis using a handheld data collector and laser reader. The re-inventory data is downloaded into a PC so that location changes and disposal information can be updated.

A blue recycling bin is located in most of the laboratories for collecting empty containers. This is so that the inventory can be maintained as up to date as possible. It is essential that all users comply with this collection system. Please get in the habit of saving all containers for collection. Once a chemical is consumed, it must be removed from the system to provide maximum benefits from the inventory. The recycling bins will be emptied by the EHS Office periodically. If chemical containers are saved and washed for reuse, please provide the EHS Office with the tag number(s) from the empty container(s).

Chemical Requisition Forms
The Chemical Requisition Forms are for ordering chemicals, only. Please place orders for equipment and other non-chemical items separately on the Requisition for Supplies Form.

Requisition forms are available in department offices and should be filled out and filed as follows:

Complete DEPT, DATE, CHARGE TO, and USER NAME.
The ROOM # is the room or lab where the chemical(s) will be used and/or stored. This MUST be completed for proper inventory tracking. Complete the VENDOR section; for withdrawals indicate Chemical Stores or Stockroom.

Complete the QUANTITY/SIZE, DESCRIPTION, and CATALOG/PRODUCT #. Often it is best to leave the price box blank if unknown, because the current market or discounted price is usually different from the stated catalogue price. Circle YES in the CONFIRMING box if the order has already been placed to prevent duplication. The PO number should be recorded as well. If the shipping or delivery METHOD is known, complete this block, otherwise leave it blank.

The AUTHORIZED SIGNATURE block is for the signature of the person authorized for the account code in the CHARGE TO box.

Standard Operating Procedures Example

General

- Follow all safety instructions carefully. Use equipment only for its desired purpose.
- Become thoroughly acquainted with the location and use of safety equipment such as safety showers, fire blankets, eyewash fountains, fire extinguisher, and exits.
- Know the safety rules and procedures that apply to the work being done. Determine the potential hazards and precautions before undertaking any operation.
- Be alert to any unsafe conditions and work practices and call attention to them immediately, so that appropriate corrections can be made as soon as possible.
- Horseplay, practical jokes, or other behavior which might confuse, startle, or distract other workers in the laboratory is forbidden.
- Be certain all chemicals are correctly and clearly labeled. Post warning signs when unusual hazards, such as radiation, laser, use of carcinogens, or highly toxic chemicals exist.

Personal Protective Equipment Section Example

Eyes

Everyone in the laboratory including visitors **MUST** wear appropriate eye protection at all times, even when not performing a chemical operation. All protective eye wear used in the laboratory must meet the ANSI Z87.1 standard.

Regular prescription eyeglasses (with or without sideshields) are not allowed as a substitution for safety glasses or splash goggles. Faculty and staff may obtain prescription safety glasses (with side shields). See our Prescription Safety Glasses Program for more information.

Faculty and staff who don't obtain prescription safety glasses must wear safety glasses (for impact hazard) or goggles (for splash hazard) designed to go over their prescription glasses.

Full face shields with safety glasses or goggles underneath will be worn when conducting an operation that may result in a violent reaction.

Contact lenses can be worn without increased risks in most laboratory environments. Contact lenses will not be substituted for appropriate eye protection. In other words, if the use of contacts is allowed by the laboratory supervisor, approved eye protection will also be worn.

Contact lens wearers will be identified prior to beginning any laboratory operations. Laboratory supervisors who allow contact lens use and the contact lens wearers must be familiar with emergency procedures. Faculty and staff who wear contact lenses should consider obtaining a pair of prescription safety glasses.

Clothing

Clothing will offer protection from splashes and spills, should be easily removed in case of an accident, and should be fire resistant. HIGH HEELED OR OPEN TOED SHOES, SANDALS, AND FLIP-FLOPS **WILL NOT BE WORN** in the laboratory. SHORTS, SHORT DRESSES, MINISKIRTS, TANK TOPS, AND HALTER TOPS ARE ALSO **PROHIBITED**. Long hair and loose clothing will be constrained.

Jewelry such as rings, bracelets, and watches will not be worn.

Gloves
Gloves are an important part of personal protection when used correctly. Check to make sure there are no cracks, breaks, or small holes prior to use. Gloves will be removed before handling telephones, doorknobs, writing instruments, and notebooks to prevent the unintentional spread of chemicals.

Gloves will be changed on a periodic basis depending on the nature of work and the chemicals used. Glove material must be appropriate for the chemicals being handled and the operation being performed. A chemical resistance chart that lists the material or materials that you are using should be consulted.

See also Personal Protective Equipment for chemical handling.

Personal Hygiene
- Do not prepare, store, or consume food or beverages in the laboratory.
- Do not apply cosmetics in the laboratory.
- Wash hands and lower arms before leaving the lab, even if gloves were worn. Do not use solvents to wash skin. Solvents remove the protective oils from the skin and cause drying, redness, and irritation.
- Never wear or bring lab coats or aprons in areas where food is stored or consumed.
- Never pipette or siphon by mouth.
- Food will not be stored in a refrigerator used for chemical storage. Refrigerators used for chemical storage will clearly labeled "**Chemicals Only - No Food**". Conversely refrigerators used for food storage, which will be located outside the laboratory area, will be labeled "**Food Only -No Chemicals**."

Housekeeping
In the laboratory and elsewhere, keeping things clean and neat generally leads to a safer environment. When housekeeping standards fall, safety performance inevitably deteriorates. Therefore:
- Work areas will be kept clean and free from obstructions. Keep isles free of chairs, boxes, equipment, and waste receptacles.
- Lab benches and floors will be cleaned regularly and kept free of clutter.
- Store hazardous chemicals on the floor or above eye level.
- Access to emergency equipment, exits, control panels, and outlets will be kept clear at all times.
- Drawers and cabinets will be closed when not in use.
- Full hazardous waste collection containers will be removed from the laboratory.
- Unneeded or unwanted reagents will be returned to the division stockroom.
- Spilled chemicals will be cleaned up immediately and disposed of properly.

Unattended Operations
Reactions that are left to run unattended overnight or at other times are prime sources for fire, floods, or explosions. Plan for interruptions in electrical, gas, or water service. Equipment such as power stirrers, hot plates, heating mantles, and water condensers will not run unattended without fail-safe provisions.

Unattended operations will be checked regularly. Appropriate signs will be posted indicating that a laboratory operation is in progress. The sign will include any hazards associated with the operation and a telephone number of the person(s) to be contacted in an emergency.

Personal Protective Equipment Section

Purpose

Your Employer is required to provide all Employees with required PPE to suit the task and known hazards. This Chapter covers the requirements for Personal Protective Equipment with the exception of PPE used for respiratory protection or PPE required for hazardous material response to spills or releases. Applicable OSHA Standards are 1910 Subpart 1 App B and 1910.120 App B, 132, 133, 136, and 138.

General Rules
Design
All personal protective equipment shall be of safe design and construction for the work to be performed.

Hazard Assessment and Equipment Selection
Hazard analysis procedures shall be used to assess the workplace to determine if hazards are present, or are likely to be present, which necessitate the use of personal protective equipment (PPE). If such hazards are present, or likely to be present, the following actions will be taken:
1) Select, and have each affected Employee use, the proper PPE.
2) Communicate selection decisions to each affected Employee.
3) Select PPE that properly fits each affected employee.

Defective and damaged equipment.
Defective or damaged personal protective equipment shall not be used.

Training
All Employees who are required to use PPE shall be trained to know at least the following:
1) When PPE is necessary;
2) What PPE is necessary;
3) How to properly don, remove, adjust, and wear PPE;
4) The limitations of the PPE
5) The proper care, maintenance, useful life and disposal of the PPE.

Each affected Employee shall demonstrate an understanding of the training and the ability to use PPE properly, before being allowed to perform work requiring the use of PPE.

Certification of training for PPE is required by OSHA and shall be accomplished by using the Job Safety Checklist to verify that each affected Employee has received and understood the required PPE training.

Controlling Hazards
PPE devices alone should not be relied on to provide protection against hazards, but should be used in conjunction with guards, engineering controls, and sound manufacturing practices.

Selection Guidelines

The general procedure for selection of protective equipment is to:

a) become familiar with the potential hazards and the type of protective equipment that is available, and what it can do; i.e., splash protection, impact protection, etc.

b) compare the hazards associated with the environment; i.e., impact velocities, masses, projectile shape, radiation intensities, with the capabilities of the available protective equipment;

c) select the protective equipment which ensures a level of protection greater than the minimum required to protect employees from the hazards

d) fit the user with the protective device and give instructions on care and use of the PPE. It is very important that end users be made aware of all warning labels for and limitations of their PPE.

Fitting the Device

Careful consideration must be given to comfort and fit. PPE that fits poorly will not afford the necessary protection. Continued wearing of the device is more likely if it fits the wearer comfortably. Protective devices are generally available in a variety of sizes. Care should be taken to ensure that the right size is selected.

Devices with Adjustable Features

Adjustments should be made on an individual basis for a comfortable fit that will maintain the protective device in the proper position. Particular care should be taken in fitting devices for eye protection against dust and chemical splash to ensure that the devices are sealed to the face. In addition, proper fitting of helmets is important to ensure that it will not fall off during work operations. In some cases a chin strap may be necessary to keep the helmet on an employee's head. (Chin straps should break at a reasonably low force, however, so as to prevent a strangulation hazard). Where manufacturer's instructions are available, they should be followed carefully.

Eye and Face Protection

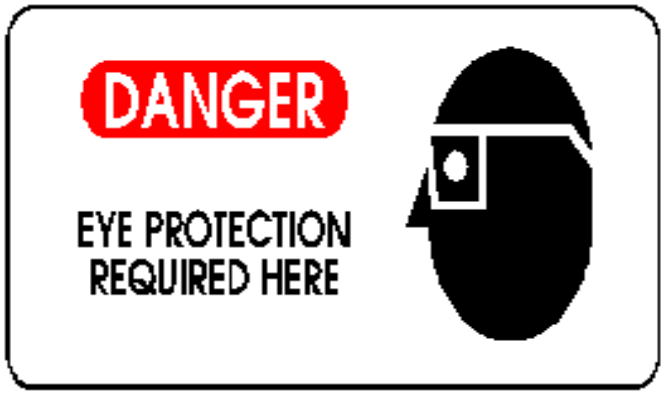
Each affected employee shall use appropriate eye or face protection when exposed to eye or face hazards from flying particles, molten metal, liquid chemicals, acids or caustic liquids, chemical gases or vapors, or potentially injurious light radiation.

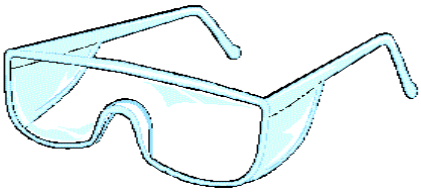
- ✓ Each affected employee shall use eye protection that provides side protection when there is a hazard from flying objects. Detachable side protectors are acceptable.
- ✓ Each affected employee who wears prescription lenses while engaged in operations that involve eye hazards shall wear eye protection that incorporates the prescription in its design, or shall wear eye protection that can be worn over the prescription lenses without disturbing the proper position of the prescription lenses or the protective lenses.
- ✓ Eye and face PPE shall be distinctly marked to facilitate identification of the manufacturer.
- ✓ Each affected employee shall use equipment with filter lenses that have a shade number appropriate for the work being performed for protection from injurious light radiation. The following is a listing of appropriate shade numbers for various operations.

Filter Lenses for Protection Against Radiant Energy			
Operations	**Electrode Size 1/32 in**	**Arc Current**	**Protective Shade**
Shielded metal arc welding	Less than 3	Less than 60	7
	3-5	60-160	8
	5-8	160-250	10
	More than 8	250-550	11
Torch brazing			3
Torch soldering			2
Note: as a rule of thumb, start with a shade that is too dark to see the weld zone. Then go to a lighter shade which gives sufficient view of the weld zone without going below the minimum. In oxy-fuel gas welding or cutting where the torch produces a high yellow light, it is desirable to use a filter lens that absorbs the yellow or sodium line in the visible light of the (spectrum) operation.			

Always wear your eye protection and not on your head as a tiara.

Eye Protection is a Requirement When Working With Hazardous Materials

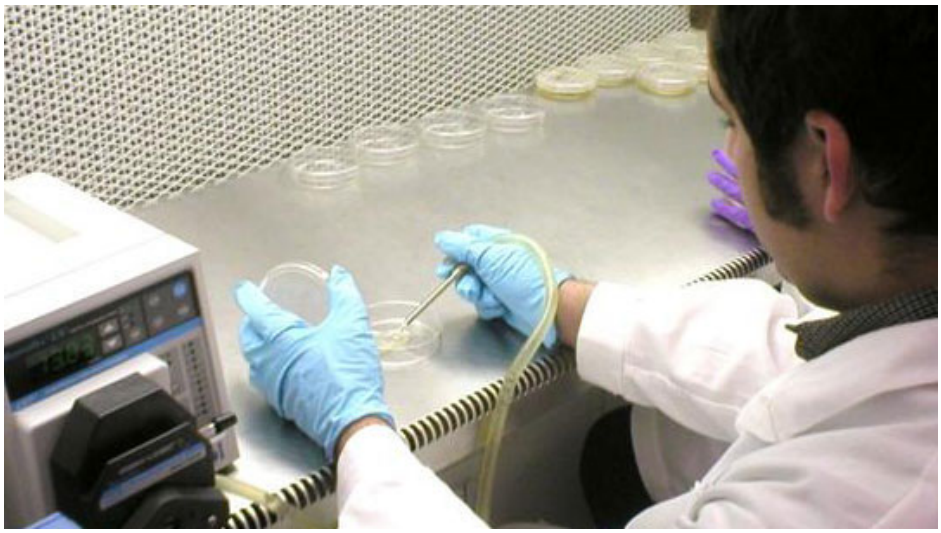




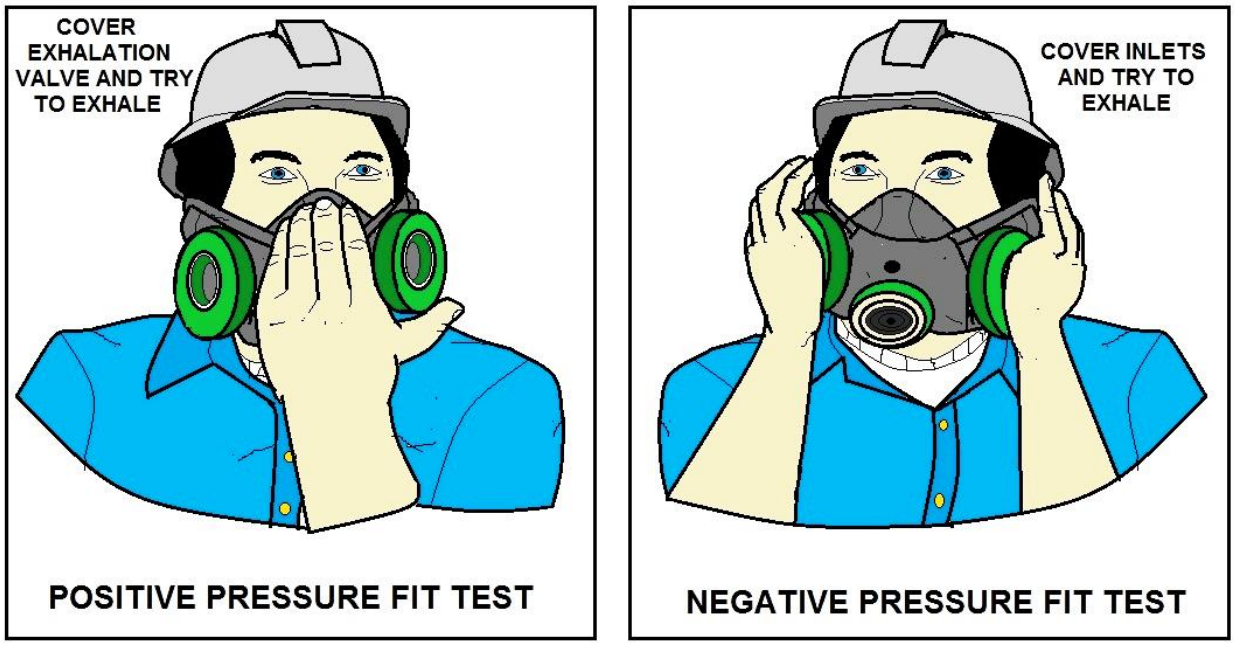
Safety Glasses (spectacles)

Safety glasses (spectacles) with side shields are the minimum level of eye protection required for any type of work with or around hazardous chemicals or chemical products.

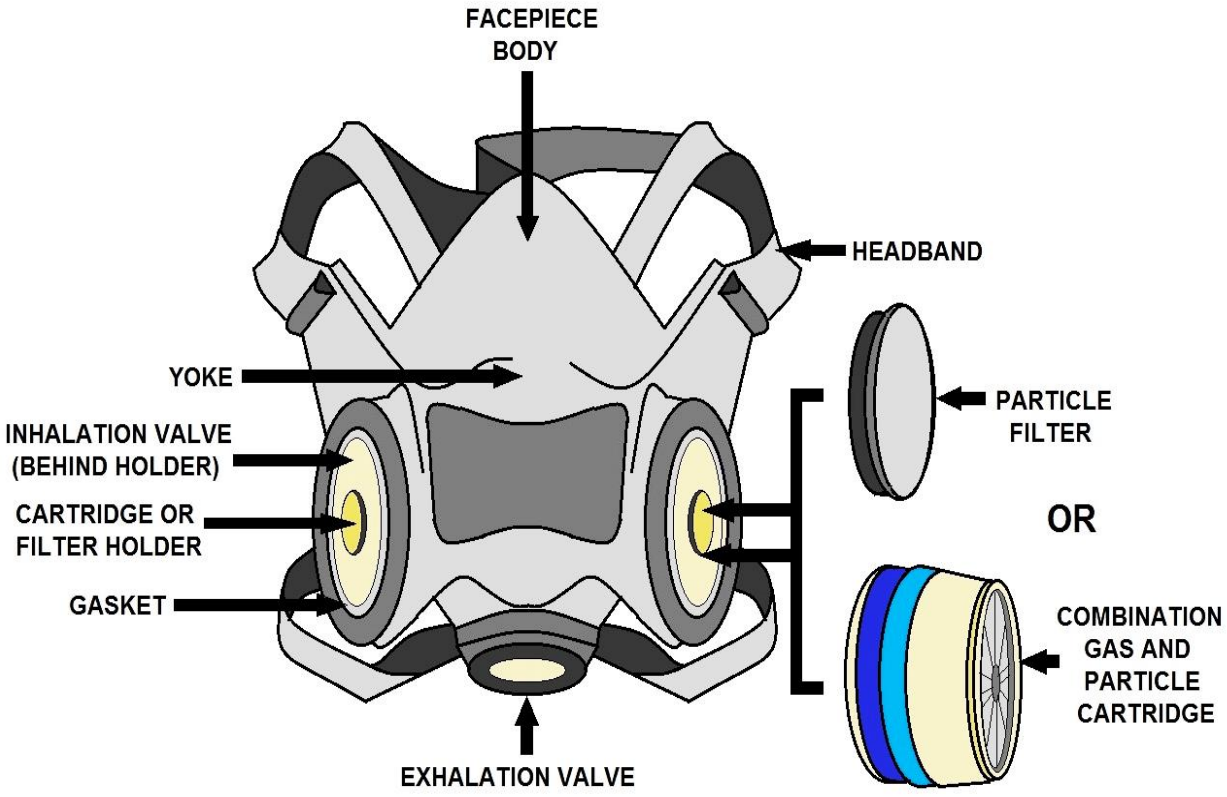
- Prescription glasses (with or without side shields) are not an acceptable substitution for safety glasses. Prescription safety glasses are available.
- Safety glasses do not provide complete protection against splash or spray because they do not fit tightly to your face.
- Safety glasses must meet ANSI Z87.1 standards (It will be marked on the frame).
- Safety glasses must be worn anytime chemicals or chemical products are handled.



Wear your glasses! Or lose those peepers.



POSITIVE AND NEGATIVE PRESSURE FIT CHECKS



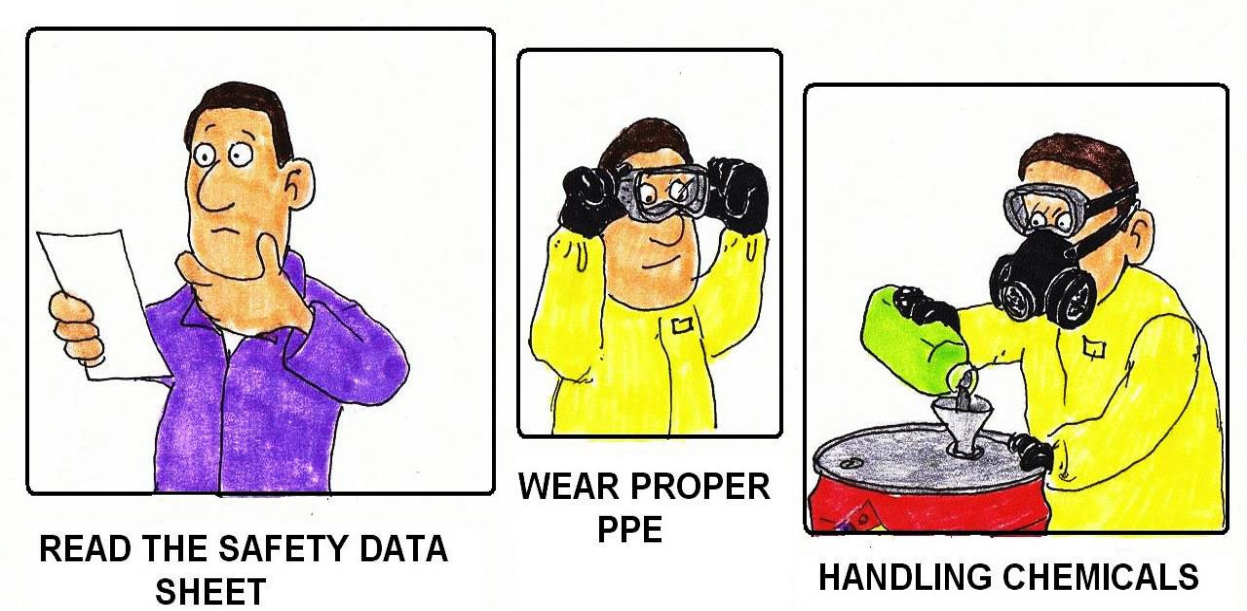
BASIC PARTS OF A HALF-FACEPIECE RESPIRATOR

CLEANING AN SCBA MASK

Goggles, Splash (Indirect Venting)

Splash goggles are your next level of defense against chemical eye injury. Splash goggles have indirect ventilation and form a tight seal to the face.

- Splash goggles must be worn anytime there is the chance of a chemical splash or spray.
- Safety glasses are not an acceptable substitution for goggles and do not provide complete protection against splash or spray because they do not fit tightly to your face.
- Operations requiring goggles include but are not limited to pouring, scrubbing, rinsing, spraying (aerosols), washing, and dispensing.
- Splash goggles must also meet ANSI Z87.1 standards.



Face Shield

Face shields protect the eyes, face, and neck from chemical splashes and spray as well as flying particles.

- Face shields will not be worn independently. In other words, safety glasses or goggles must be worn underneath face shields for complete protection.
- Face shields are necessary anytime there is a severe risk of splash or spray or if the material in use is highly hazardous, for example highly corrosive alkaline material.

Selection Chart Guidelines for Eye and Face Protection

The following chart provides general guidance for the proper selection of eye and face protection to protect against hazards associated with the listed hazard ***"source"*** operations.

Source	Hazard	Protection
IMPACT - Chipping, grinding machining, masonry work, woodworking, sawing, drilling, chiseling, powered fastening, riveting, and sanding	Flying fragments, objects, large chips, particles, sand, dirt, etc.	Spectacles with side protection, goggles, face shield For severe exposure, use face shield
HEAT-Furnace operation and arc welding	Hot sparks	Face shields, spectacles with side. For severe exposure use faceshield.
CHEMICALS-Acid and chemical handling, degreasing, plating	Splash	Goggles, eyecup and cover types. For severe exposure, use face shield.
DUST - Woodworking, buffing, general, buffing, general dusty conditions.	Nuisance dust	Goggles, eye cup and cover type

Selection Guidelines for Head Protection

All head protection is designed to provide protection from impact and penetration hazards caused by falling objects.

Head protection is also available which provides protection from electric shock and burn. When selecting head protection, knowledge of potential electrical hazards is important.

Class A helmets, in addition to impact and penetration resistance, provide electrical protection from low-voltage conductors (they are proof tested to 2,200 volts).

Class B helmets, in addition to impact and penetration resistance; provide electrical protection from high-voltage conductors (they are proof tested to 20,000 volts).

Class C helmets provide impact and penetration resistance (they are usually made of aluminum which conducts electricity), and should not be used around electrical hazards.

Where falling object hazards are present, helmets must be worn. Some examples include: working below other workers who are using tools and materials which could fall; working around or under conveyor belts which are carrying parts or materials; working below machinery or processes which might cause material or objects to fall; and working on exposed energized conductors.

Foot Protection

General Requirements

Each affected employee shall wear protective footwear when working in areas where there is a danger of foot injuries due to falling or rolling objects, or objects piercing the sole, and where employee's feet are exposed to electrical hazards.

Selection Guidelines for Foot Protection

Safety shoes and boots provide both impact and compression protection. Where necessary, safety shoes can be obtained which provide puncture protection. In some work situations, metatarsal protection should be provided, and in other special situations electrical conductive or insulating safety shoes would be appropriate.

Safety shoes or boots with impact protection would be required for carrying or handling materials such as packages, objects, parts or heavy tools, which could be dropped; and, for other activities where objects might fall onto the feet.

Safety shoes or boots with compression protection would be required for work activities involving skid trucks (manual material handling carts) around bulk rolls (such as paper rolls) and around heavy pipes, all of which could potentially roll over an employee's feet.

Safety shoes or boots with puncture protection would be required where sharp objects such as nails, wire, tacks, screws, large staples, scrap metal etc., could be stepped on by employees causing a foot injury.

Hand Protection

General Requirements
Hand protection is required when employees' hands are exposed to hazards such as those from skin absorption of harmful substances; severe cuts or lacerations; severe abrasions; punctures; chemical burns; thermal burns; and harmful temperature extremes.

Selection guidelines for hand protection
Selection of hand PPE shall be based on an evaluation of the performance characteristics of the hand protection relative to the task(s) to be performed, conditions present, duration of use, and the hazards and potential hazards identified.

Gloves are often relied upon to prevent cuts, abrasions, burns, and skin contact with chemicals that are capable of causing local or systemic effects following dermal exposure.

There is no glove that provides protection against all potential hand hazards, and commonly available glove materials provide only limited protection against many chemicals. Therefore, it is important to select the most appropriate glove for a particular application and to determine how long it can be worn, and whether it can be reused.

It is also important to know the performance characteristics of gloves relative to the specific hazard anticipated; e.g., chemical hazards, cut hazards, flame hazards, etc.

Before purchasing gloves, request documentation from the manufacturer that the gloves meet the appropriate test standard(s) for the hazard(s) anticipated. Other factors to be considered for glove selection in general include:

(A) As long as the performance characteristics are acceptable, in certain circumstances, it may be more cost effective to regularly change cheaper gloves than to reuse more expensive types.
(B) The work activities of the employee should be studied to determine the degree of dexterity required, the duration, frequency, and degree of exposure of the hazard, and the physical stresses that will be applied.

Selection of gloves for protection against chemical hazards:

(A) The toxic properties of the chemical(s) must be determined; in particular, the ability of the chemical to cause local effects on the skin and/or to pass through the skin and cause systemic effects.
(B) Generally, any "**chemical resistant**" glove can be used for dry powders;
(C) For mixtures and formulated products (unless specific test data are available), a glove should be selected on the basis of the chemical component with the shortest breakthrough time, since it is possible for solvents to carry active ingredients through polymeric materials.
(D) Employees must be able to remove the gloves in such a manner as to prevent skin contamination.

Protective Clothing Applications

A. The purpose of chemical protective clothing and equipment is to shield or isolate individuals from the chemical, physical, and biological hazards that may be encountered during hazardous materials operations. During chemical operations, it is not always apparent when exposure occurs. Many chemicals pose invisible hazards and offer no warning properties.

B. These guidelines describe the various types of clothing that are appropriate for use in various chemical operations, and provides recommendations in their selection and use. The final paragraph discusses heat stress and other key physiological factors that must be considered in connection with protective clothing use.

C. It is important that protective clothing users realize that no single combination of protective equipment and clothing is capable of protecting you against all hazards. Thus protective clothing should be used in conjunction with other protective methods. For example, engineering or administrative controls to limit chemical contact with personnel should always be considered as an alternative measure for preventing chemical exposure.

The use of protective clothing can itself create significant wearer hazards, such as heat stress, physical and psychological stress, in addition to impaired vision, mobility, and communication. In general, the greater the level of chemical protective clothing, the greater the associated risks. For any given situation, equipment and clothing should be selected that provide an adequate level of protection. Overprotection as well as under-protection can be hazardous and should be avoided.

II. Descriptions.
A. Protective Clothing Applications.

1. Protective clothing must be worn whenever the wearer faces potential hazards arising from chemical exposure. ***Some examples include:***

- Emergency response;
- Chemical manufacturing and process industries;
- Hazardous waste site cleanup and disposal;
- Asbestos removal and other particulate operations; and
- Agricultural application of pesticides.

2. Within each application, there are several operations which require chemical protective clothing. For example, in emergency response, the following activities dictate chemical protective clothing use:

- ✓ **Site Survey**: The initial investigation of a hazardous materials incident; these situations are usually characterized by a large degree of uncertainty and mandate the highest levels of protection.

- ✓ **Rescue**: Entering a hazardous materials area for the purpose of removing an exposure victim; special considerations must be given to how the selected protective clothing may affect the ability of the wearer to carry out rescue and to the contamination of the victim.

- ✓ **Spill Mitigation**: Entering a hazardous materials area to prevent a potential spill or to reduce the hazards from an existing spill (i.e., applying a chlorine kit on railroad tank car). Protective clothing must accommodate the required tasks without sacrificing adequate protection.

- ✓ **Emergency Monitoring**: Outfitting personnel in protective clothing for the primary purpose of observing a hazardous materials incident without entry into the spill site. This may be applied to monitoring contract activity for spill cleanup.

- ✓ **Decontamination**: Applying decontamination procedures to personnel or equipment leaving the site; in general a lower level of protective clothing is used by personnel involved in decontamination.

B. Clothing Ensemble. The approach in selecting personal protective clothing must encompass an "**ensemble**" of clothing and equipment items which are easily integrated to provide both an appropriate level of protection and still allow one to carry out activities involving chemicals.

In many cases, simple protective clothing by itself may be sufficient to prevent chemical exposure, such as wearing gloves in combination with a splash apron and faceshield (or safety goggles).

1. The following is a checklist of components that may form the chemical protective ensemble:

- ➢ Protective clothing (suit, coveralls, hoods, gloves, boots);
- ➢ Respiratory equipment (SCBA, combination SCBA/SAR, air purifying respirators);
- ➢ Cooling system (ice vest, air circulation, water circulation);
- ➢ Communications device;
- ➢ Head protection;
- ➢ Eye protection;
- ➢ Ear protection;
- ➢ Inner garment; and
- ➢ Outer protection (overgloves, overboots, flashcover).

2. Factors that affect the selection of ensemble components include:

- ✓ How each item accommodates the integration of other ensemble components. Some ensemble components may be incompatible due to how they are worn (e.g., some SCBA's may not fit within a particular chemical protective suit or allow acceptable mobility when worn).

- ✓ The ease of interfacing ensemble components without sacrificing required performance (e.g. a poorly fitting overglove that greatly reduces wearer dexterity).

- ✓ Limiting the number of equipment items to reduce donning time and complexity (e.g. some communications devices are built into SCBA's which as units are NIOSH certified).

C. Levels of Protection.
1. Table VIII:1-1 lists ensemble components based on the widely used EPA Levels of Protection: Levels A, B, C, and D. These lists can be used as the starting point for ensemble creation; however, each ensemble must be tailored to the specific situation in order to provide the most appropriate level of protection.

For example, if an emergency response activity involves a highly contaminated area or if the potential of contamination is high, it may be advisable to wear a disposable covering such as Tyvek coveralls or PVC splash suits, over the protective ensemble.

TABLE VIII: 1-1. EPA Levels of Protection

LEVEL A:
Vapor protective suit (meets NFPA 1991)
Pressure-demand, full-face SCBA
Inner chemical-resistant gloves, chemical-resistant safety boots, two-way radio communication
OPTIONAL: Cooling system, outer gloves, hard hat
Protection Provided: Highest available level of respiratory, skin, and eye protection from solid, liquid and gaseous chemicals.
Used When: The chemical(s) have been identified and have high level of hazards to respiratory system, skin and eyes. Substances are present with known or suspected skin toxicity or carcinogenetic. Operations must be conducted in confined or poorly ventilated areas.
Limitations: Protective clothing must resist permeation by the chemical or mixtures present. Ensemble items must allow integration without loss of performance.

LEVEL B:
Liquid splash-protective suit (meets NFPA 1992)
Pressure-demand, full-face piece SCBA
Inner chemical-resistant gloves, chemical-resistant safety boots, two-way radio communications, Hard hat.
OPTIONAL: Cooling system, outer gloves.
Protection Provided: Provides same level of respiratory protection as Level A, but less skin protection. Liquid splash protection, but no protection against chemical vapors or gases.
Used When: The chemical(s) have been identified but do not require a high level of skin protection. Initial site surveys are required until higher levels of hazards are identified. The primary hazards associated with site entry are from liquid and not vapor contact.
Limitations: Protective clothing items must resist penetration by the chemicals or mixtures present. Ensemble items must allow integration without loss of performance.

LEVEL C:
Support Function Protective Garment (meets NFPA 1993)
Full-facepiece, air-purifying, canister-equipped respirator
Chemical resistant gloves and safety boots
Two-way communications system, hard hat
OPTIONAL: Faceshield, escape SCBA
Protection Provided: The same level of skin protection as Level B, but a lower level of respiratory protection. Liquid splash protection but no protection to chemical vapors or gases.
Used When: Contact with site chemical(s) will not affect the skin. Air contaminants have been identified and concentrations measured. A canister is available which can remove the contaminant. The site and its hazards have been completely characterized.
Limitations: Protective clothing items must resist penetration by the chemical or mixtures present. Chemical airborne concentration must be less than IDLH levels. The atmosphere must contain at least 19.5% oxygen.
Not Acceptable for Chemical Emergency Response

LEVEL D:
Coveralls, safety boots/shoes, safety glasses or chemical splash goggles
OPTIONAL: Gloves, escape SCBA, face-shield
Protection Provided: No respiratory protection, minimal skin protection.
Used When: The atmosphere contains no known hazard. Work functions preclude splashes, immersion, potential for inhalation, or direct contact with hazard chemicals.
Limitations: This level should not be worn in the Hot Zone. The atmosphere must contain at least 19.5% oxygen.
Not Acceptable for Chemical Emergency Response

1. The type of equipment used and the overall level of protection should be reevaluated periodically as the amount of information about the chemical situation or process increases, and when workers are required to perform different tasks. Personnel should upgrade or downgrade their level of protection only with concurrence with the site supervisor, safety officer, or plant industrial hygienist.

2. The recommendations in Table VIII: 1-1 serves only as guidelines. It is important for you to realize that selecting items by how they are designed or configured alone is not sufficient to ensure adequate protection. In other words, just having the right components to form an ensemble is not enough. The EPA levels of protection do not define what performance the selected clothing or equipment must offer.

Many of these considerations are described in the "**limiting criteria**" column of Table VIII: 1-1. Additional factors relevant to the various clothing and equipment items are described in subsequent Paragraphs.

E. Ensemble Selection Factors.

1. **Chemical Hazards**. Chemicals present a variety of hazards such as toxicity, corrosiveness, flammability, reactivity, and oxygen deficiency. Depending on the chemicals present, any combination of hazards may exist.

2. **Physical Environment**. Chemical exposure can happen anywhere: in industrial settings, on the highways, or in residential areas.

It may occur either indoors or outdoors; the environment may be extremely hot, cold, or moderate; the exposure site may be relatively uncluttered or rugged, presenting a number of physical hazards; chemical handling activities may involve entering confined spaces, heavy lifting, climbing a ladder, or crawling on the ground. The choice of ensemble components must account for these conditions.

3. **Duration of Exposure**. The protective qualities of ensemble components may be limited to certain exposure levels (e.g. material chemical resistance, air supply). The decision for ensemble use time must be made assuming the worst case exposure so that safety margins can be applied to increase the protection available to the worker.

4. **Protective Clothing or Equipment Available**. Hopefully, an array of different clothing or equipment is available to workers to meet all intended applications. Reliance on one particular clothing or equipment item may severely limit a facility's ability to handle a broad range of chemical exposures. In its acquisition of equipment and clothing, the safety department or other responsible authority should attempt to provide a high degree of flexibility while choosing protective clothing and equipment that is easily integrated and provides protection against each conceivable hazard.

F. Classification of Protective Clothing.

Personal protective clothing includes the following:

- ✓ Fully encapsulating suits;
- ✓ Non-encapsulating suits;
- ✓ Gloves, boots, and hoods;
- ✓ Firefighter's protective clothing;
- ✓ Proximity, or approach clothing;
- ✓ Blast or fragmentation suits; and
- ✓ Radiation-protective suits.

1. Firefighter turnout clothing, proximity gear, blast suits, and radiation suits by themselves are not acceptable for providing adequate protection from hazardous chemicals.

2. Table VIII:1-2 describes various types of protection clothing available, details the type of protection they offer, and lists factors to consider in their selection and use.

TABLE VIII: 1-2. Types of Protective Clothing for Full Body Protection

Description
Type of Protection Use Considerations

Fully encapsulating suit

- ✓ One-piece garment. Boots and gloves may be integral, attached and replaceable, or separate.

- ✓ Protects against splashes, dust, gases, and vapors.

- ✓ Does not allow body heat to escape. May contribute to heat stress in wearer, particularly if worn in conjunction with a closed-circuit SCBA; a cooling garment may be needed. Impairs worker mobility, vision, and communication.

Non-encapsulating suit

- ✓ Jacket, hood, pants or bib overalls, and one-piece coveralls.
- ✓ Protects against splashes, dust, and other materials but not against gases and vapors. Does not protect parts of head or neck.
- ✓ Do not use where gas-tight or pervasive splashing protection is required. May contribute to heat stress in wearer. Tape-seal connections between pant cuffs and boots and between gloves and sleeves.

Aprons, leggings, and sleeve protectors

- ✓ Fully sleeved and gloved apron. Separate coverings for arms and legs. Commonly worn over non-encapsulating suit.
- ✓ Provides additional splash protection of chest, forearms, and legs.

Whenever possible, should be used over a non-encapsulating suit to minimize potential heat stress. Useful for sampling, labeling, and analysis operations. Should be used only when there is a low probability of total body contact with contaminants.

Firefighters' protective clothing

Gloves, helmet, running or bunker coat, running or bunker pants (NFPA No. 1971, 1972, 1973, and boots (1974)).

Protects against heat, hot water, and some particles. Does not protect against gases and vapors, or chemical permeation or degradation. NFPA Standard No. 1971 specifies that a garment consists of an outer shell, an inner liner and a vapor barrier with a minimum water penetration of 25 lb/in^2 (1.8 kg/cm2) to prevent passage of hot water. Decontamination is difficult. Should not be worn in areas where protection against gases, vapors, chemical splashes or permeation is required.

Proximity garment (approach suit)

- ✓ One- or two-piece over-garment with boot covers, gloves, and hood of aluminized nylon or cotton fabric. Normally worn over other protective clothing, firefighters' bunker gear, or flame-retardant coveralls.
- ✓ Protects against splashes, dust, gases, and vapors.
- ✓ Does not allow body heat to escape. May contribute to heat stress in wearer, particularly if worn in conjunction with a closed-circuit SCBA; a cooling garment may be needed. Impairs worker mobility, vision, and communication.

Blast and fragmentation suit

- ✓ Blast and fragmentation vests and clothing, bomb blankets, and bomb carriers.
- ✓ Provides some protection against very small detonations. Bomb blankets and baskets can help redirect a blast.
- ✓ Does not provide for hearing protection.

Radiation-contamination protective suit

- ✓ Various types of protective clothing designed to prevent contamination of the body by radioactive particles.
- ✓ Protects against alpha and beta particles. Does not protect against gamma radiation.
- ✓ Designed to prevent skin contamination. If radiation is detected on site, consult an experienced radiation expert and evacuate personnel until the radiation hazard has been evaluated.

Flame/fire retardant coveralls.

- ✓ Normally worn as an undergarment.
- ✓ Provides protection from flash fires.
- ✓ Adds bulk and may exacerbate heat stress problems and impair mobility

F. Classification of Chemical Protective Clothing. Table VIII:1-3 provides a listing of clothing classifications. Clothing can be classified by design, performance, and service life.

LEVEL A Suits
Vapor protective suit (meets NFPA 1991)
Pressure-demand, full-face SCBA
Inner chemical-resistant gloves, chemical-resistant safety boots, two-way radio communication
Limitations: Protective clothing must resist permeation by the chemical or mixtures present. Ensemble items must allow integration without loss of performance.

Working Alone Policy Example- *Never Work Alone if Possible*

No one will work in a laboratory building alone. If a laboratory supervisor determines that an employee or student can work alone in a laboratory room, arrangements will be made for frequent contact with someone in the immediate area.

Contact will be maintained with Security during work outside of normal hours.

Security

- All laboratories will be locked when unattended and not in use to protect employees, students, equipment, supplies, and the public.
- Locked storage cabinets will be utilized for expensive, hazardous, or sensitive items.
- All suspicious persons or actions will be reported to Security immediately.

Glassware

Careful handling and storage procedures are necessary to avoid damaging glassware.

- Damaged or broken glassware will be discarded. Broken glass will be placed in designated containers. Broken glass collection containers will be labeled, "**CAUTION - Broken Glass**" to prevent injury to custodians and garbage handlers.
- Adequate hand protection will be worn when inserting glass tubing into rubber stoppers or corks, or when placing rubber tubing on glass connections.
- Glass apparatus under vacuum will be handled with extreme care to prevent implosion. Glassware under vacuum will be taped or shielded and only glassware designed for vacuum use such as Dewar flasks will be used for that purpose.
- Glassware will be cleaned at the laboratory sink or in a laboratory dishwasher. The use of strong oxidizer agents such as nitric, chromic, or sulfuric acid will be minimized.
- Proper hand protection will be worn when handling broken glass.
- Glassware or bottles used in laboratory operations will not be used to prepare or store food or beverages.

Systems Under Pressure.

- Reactions under pressure will be carried out in apparatus that is designed to withstand the full pressure of the system.
- All pressurized apparatus will have appropriate relief devices.

Compressed Gases

- Gas cylinders will be strapped or chained securely to a wall or bench top.
- Gas cylinders will be capped when not in use.
- Flammable compressed gases will be stored away from heat, oxygen, and sources of ignition.
- The appropriate regulator will be used.
- Gas cylinders will not be bled completely empty.
- Empty gas cylinders will be labeled as such and separated from full ones.
- Gas cylinders will be transported using gas cylinder carts specifically designed for this purpose.

Chemical Storage Policy

General

- Every chemical container in the laboratory will have a definite storage place and must be returned to that location after each use. Containers will not be left on bench tops overnight.
- Do not store chemicals on desks, bench tops, or in hoods that are used for chemical manipulations.
- Storage trays or secondary containers will be used to minimize the spread of material should a container break or leak.
- Chemicals will be stored by hazard class, not alphabetically. At the very least acids will be separated from bases and flammables will be separated from oxidizers.
- Chemical containers will be inspecting periodically. Worn or faded labels will be repaired. Unneeded or unwanted items will be donated to the surplus chemicals inventory, and deteriorated or unusable chemicals will be disposed.
- Chemical containers will be dated when opened. The receiving date will recorded in ChIM.

Toxic Substances

- Chemicals known to be highly toxic will be stored in well-ventilated areas in chemically resistant secondary containers.
- Only minimum working quantities will be present in the work area.
- Containers of suspected carcinogens or acutely toxic chemicals will carry a label such as the following**: "CAUTION - Carcinogen or CAUTION - Highly Toxic."**

Peroxide Forming Chemicals

Specific chemicals that can form dangerous concentrations of peroxides on exposure to air include cyclohexene, cycloctene, decalin (decahydronaphthalene), p-dioxane, ethyl ether anhydrous, diisopropyl ether, tetrahydrofuran, and tetralin (tetrahydronaphthalene).

- The quantity of peroxide-forming chemicals purchased will be limited to the minimum quantity required. Unused material will not be returned to the original container.
- Containers of peroxide-forming chemicals will be dated when opened, tested after 6 months, and disposed of before their expiration date.
- Peroxide-forming chemicals will be stored at the lowest possible temperature consistent with their freezing point to prevent decomposition, but will not be allowed to freeze.

Controlling Chemical Exposures

The basic routes for a chemical to enter the body in a laboratory setting are: inhalation, skin and eye contact, ingestion, and injection. The prevention of entry by one of these routes can be accomplished by control mechanisms such as engineering controls, personal protective equipment, and administrative controls. Each route can be minimized by a variety of control measures depending on the hazard and operation.

Employing administrative controls is the most desirable method for controlling chemicals exposure and must be used whenever plausible. Administrative controls include but are not limited to:

- ✓ Hazard information and education.
- ✓ Substitution of a non-hazardous or less hazardous chemical, procedure, or equipment.
- ✓ Reducing the volumes of experiments or quantities used.
- ✓ Control and minimize individual exposure times. Rotate responsibilities.
- ✓ Restrict access to an area where a hazardous chemical is in use.
- ✓ Conduct operations that produce nuisance odors outside of typical hours.
- ✓ Place proper signs on doors to indicate the hazards within and the name and phone numbers of appropriate individuals to contact in an emergency.

Inhalation

Inhalation of hazardous chemicals is the most common route of entry to the body in laboratory operations. The American Conference of Governmental Industrial Hygienists (**ACGIH**) produces annual lists of Threshold Limit Values (**TLVs**) and Short Term Exposure Limits (**STELs**) for common chemicals and biological agents used in the laboratory. These values are guides, not legal standards, and are defined as follows:

- **TLV**: Time-weighted average concentration for a normal 8-hour workday to which nearly all workers may be repeatedly exposed without adverse effect.
- **STE**L: Maximum concentration to which workers can be exposed for periods of up to 15 minutes. Such exposures should be limited to no more than 4 per day with at least 60 minutes between exposures; and the total time-weighted average should not exceed the TLV value.

Most of the 1968 TLVs were adopted by OSHA as Permissible Exposure Levels **(PELs**). To avoid significant inhalation exposures and to limit exposure to concentrations below PEL values, there are a number of control measures that can be used.

Substituting a less toxic or less volatile chemical is the most desirable measure. If substitution is not practical, ventilation will be used to reduce exposure. Dilution ventilation may be used to reduce exposure to nonhazardous nuisance vapor and odor.

All hazardous chemicals should be used in a properly functioning chemical fume hood.

For extremely toxic substances, such as those classified as poison inhalation hazards by the Department of Transportation, the use of closed systems such as a glove box may be required. If necessary, personal protective equipment will be worn to limit chemical exposures. Dust masks or half face air purifying respirators may be utilized to this end. Respirators will not be worn in laboratories without first meeting the requirements of the OSHA Respirator Standard (1910.134).

The requirements include training on proper use, selection, cleaning, and storage of respirators as well as fit testing and medical testing and surveillance to ensure that the user is physically capable of wearing a respirator. See our Respiratory Protection Program for more information.

Skin and Eye Contact
Contact with the skin is a frequent mode of chemical injury. To reduce the risk of chemicals entering the body via skin and eye contact or skin absorption, controls include substitution and ventilation as described above.

If this doesn't control the exposure the next step is the wearing of personal protective equipment such as gloves, eye protection, lab coats, aprons, appropriate shoes, and special protective equipment as required by the specific hazard present. The laboratory supervisor should consult references to determine the proper protective material for the chemicals being used.

Administrative controls to reduce skin/eye contact exposure include:

- ✓ Setting up hazardous and non-hazardous areas in the laboratory.
- ✓ Enforcing sound chemical hygiene procedures such as no eating or drinking in the lab and washing hands and face after handling chemicals.

Ingestion
Most of the chemicals used in the laboratory are toxic if they enter the body by ingestion. The relative toxicity of a chemical can be determined by its LD_{50}, which is the quantity of material that in a single dose will cause the death of 50% of the test animals. It is usually expressed in grams or milligrams per kilograms of bodyweight.

Ingestion should not be a route of exposure in a laboratory setting. The best way to eliminate exposure by ingestion is to limit actual contact with all chemicals. Wear gloves and practice good hygiene measures.

Food and drink will not be stored in areas where chemicals are being used or stored. Label all chemical containers, and replace worn or faded labels ASAP.

Chemicals will not be tasted, and pipetting and siphoning of liquids will not be done by the mouth.

Injection

Exposure to chemicals by injection seldom occurs in the chemical laboratory. However, it can inadvertently occur through injury from metal or glass contaminated with chemicals or when chemicals are handled in syringes.

Attention to detail and adherence to general standard operating procedures will provide control against accidental injection exposure. Red boxes will be used to collect all used needles and syringes.

Separate collection containers will be used to collect broken glass.

Label the containers, "**CAUTION - Broken Glass**".
See also your Laboratory Waste Management Procedures.

Local Ventilation Example
Laboratory air should be replaced continuously (8 air changes/ hour). General ventilation provides only modest protection against toxic gases, aerosols, vapors and dusts. General ventilation will not be used for protection against toxins.

Local ventilation will be used to prevent harmful fumes, mists, dusts, gases, and vapors from entering the laboratory air. Your best protection is the chemical fume hood, if used properly.

Fume hoods will be inspected and validated annually by a contractor. Fume hoods will have a face velocity of at least 100 linear feet per minute with the sash in the fully opened position or at the sash catch position. If 100 fpm cannot be achieved with the sash fully open, the sash will be lowered until the face velocity is 100 fpm.

The sash will be marked at this position. Each hood used for chemical operations will be labeled with the face velocity and the date certified. The sticker will be placed on the front of the hood above the face opening. See also our Chemical Fume Hood Validation Program.

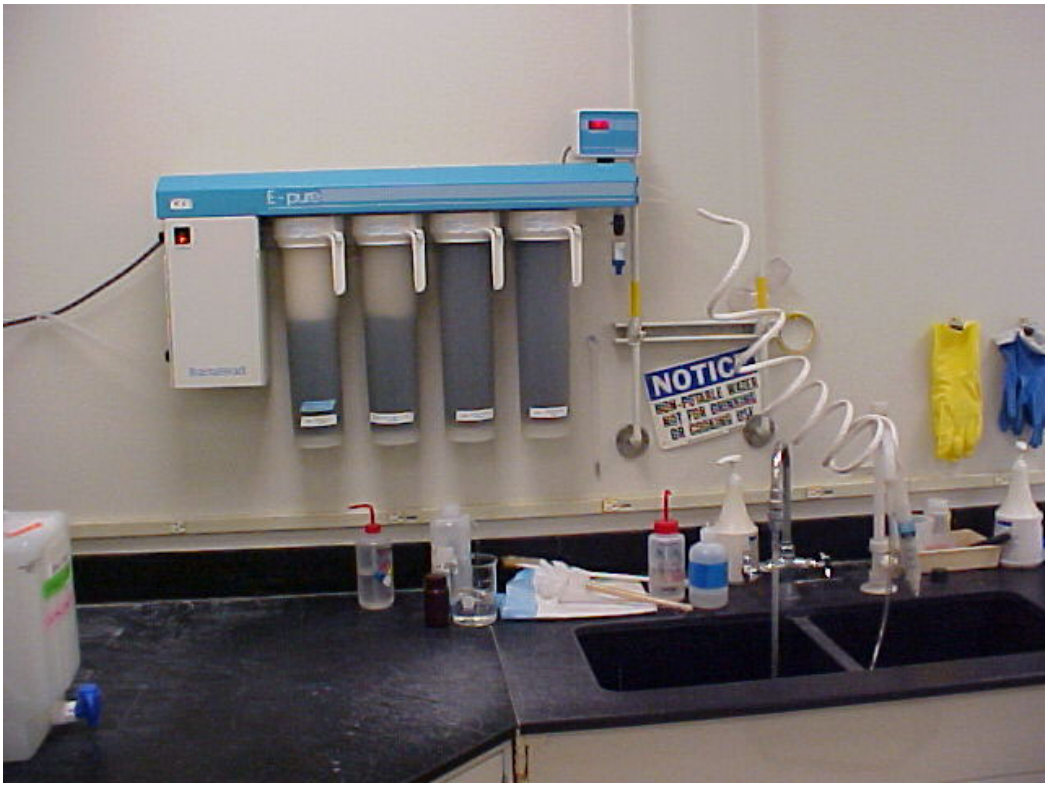
A simple visible test for users to ensure flow into fume hoods and other ventilation equipment is to tape a telltale to the hood and note its movement. Green telltales have been placed on the left hand side of each sash of each hood in the division.

Experiments or work with highly toxic substances (LD_{50} <5 mg/kg oral, <40 mg/kg skin, <1000 ppm, <500 mg/m^3) may require more specialized local ventilation such as the use of a glove box or other closed system.

Work Practices for Chemical Fume Hoods

- ✓ Set up work at least 6 inches from the face of the hood to avoid turbulence at the sash edge.
- ✓ Separate and elevate each instrument by using blocks or rack so that air can flow easily around all apparatus.
- ✓ Do not clutter the hood with unnecessary bottles or equipment. Do not use the hood for storage of chemicals or other materials if it is used for chemical operations as well. Only materials in use should be in the hood.
- ✓ Work with the sash in the lowest possible position. The sash provides a physical barrier to protect against splashes, sprays, fires, or minor explosions. Lower the sash completely when no one is working in the hood.
- ✓ Do not obstruct the slots at the back of the hood. Keep the hood baffles free of obstructions.
- ✓ Do not dismantle or modify the physical structure of your hood or exhaust system in any way without first consulting BM personnel.
- ✓ Do not place electrical receptacles or other spark producing equipment inside the hood.
- ✓ Never put your head inside an operating hood to check an experiment. The plane of the sash is the barrier between contaminated and uncontaminated air.
- ✓ Clean up spills as soon as possible.
- ✓ Do not use a hood for evaporation of chemical wastes.
- ✓ Heating of perchloric acid will only be done in a perchloric acid fume hood.

If you suspect that your fume hood is not functioning properly, let the Environmental Health and Safety Coordinator or Building Maintenance department know.



Hazard Communication Section
Revised Hazard Communication Program

2012 changes to OSHA's Hazard Communication Standard (29 CFR 1910.1200) are bringing the U.S. into alignment with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS), improving safety and health protections for America's workers. These new revisions to OSHA's current Hazard Communication Standard, the GHS is expected to prevent injuries and illnesses, save lives and improve trade conditions for chemical manufacturers. The Hazard Communication Standard in 1983 gave the workers the 'right to know,' but the new Globally Harmonized System gives workers the 'right to understand.'

The new Hazard Communication Standard still requires chemical manufacturers and importers to evaluate the chemicals they produce or import and provide hazard information to employers and workers by putting labels on containers and preparing safety data sheets. However, the old standard allowed chemical manufacturers and importers to convey hazard information on labels and material safety data sheets in whatever format they chose. The modified standard provides a single set of harmonized criteria for classifying chemicals according to their health and physical hazards and specifies hazard communication elements for labelling and safety data sheets.

The Safety Data Sheet (SDS), also known as the Material Safety Data Sheet (MSDS), is at the heart of federal OSHA’s hazard communication standard (HazCom). The SDS/MSDS is a detailed, written description of a hazardous chemical that must be kept in the workplace where such chemicals are used.

Significant new requirements were added to OSHA’s HazCom rule that will require employers to train their employees how to read and interpret the new SDS.

By December 1, 2013, employers must train their employees how to read and interpret the new SDS. Many employers will go through a phase-in period where both MSDSs and SDSs will be present in the workplace. During the phase-in period, employers may train their employees how to read and interpret SDSs, or MSDSs, or both at the same time. By June 1, 2015, all MSDSs must be replaced with SDSs.

As the global market has expanded to include many countries and languages so has the labeling of hazards of chemical products. Several years ago the United Nations recognized this as a problem and began a push for countries to adopt a standardized system of classification and labeling. As a result, in the very near future, OSHA plans to implement the new Globally Harmonized System of Classification and Labeling of Chemicals or better known as GHS. The goal is that the same set of rules for classifying hazards, and the same format and content for labels and Material Safety Data Sheets (now to be called Safety Data Sheets or SDS) will be adopted worldwide.

The new system, as is often the case with governmental programs, is running behind schedule. At this point OSHA expected to be well into GHS, but right now it appears it will go into effect in the Spring of 2012. Once implemented it should provide consistent hazard information, greater awareness of hazards, and safer use of chemicals. For employers the expectation is that it will reduce costs and ease compliance.

The big question for many employers is obviously…"How will GHS affect my company?" Depending on the type of operations you conduct in your company, the answers will vary. OSHA has developed some websites to help with the transitioning process.

GHS Concept	How it affects the employer	The challenge
Material Safety Data Sheets	MSDSs will become Safety Data Sheets (SDS). The new SDS will be in a standardized format and provide additional information including ecological information, disposal considerations, transport information and regulatory information. The consistent format will help employees in quickly finding information on the SDS.	Ensuring that all MSDSs are updated to the new SDS format and making sure this information is distributed accurately to employees will be difficult. One of the key challenges will be working with your chemical product vendors to produce the SDSs in a timely manner.
Container Labeling	The GHS standard will become a requirement and replace HMIS, NFPA or any other labeling system you are currently using. The new format includes pictograms, signal words and physical, health and environmental hazard statements. The labels must also have precautionary measures, pictograms and first aid statements along with complete chemical identification and manufacturer contact information.	Properly labeling all secondary and tertiary containers is a significant task. The employer must ensure all containers are labeled properly. This includes original containers received from vendors. Unfortunately, you cannot assume that your vendors will be able to provide the labeling information in a timely fashion. Additionally, it is unlikely OSHA will require chemical manufacturers to produce SDSs for discontinued products so employers will be stuck determining GHS labels for older products.

Training	Employees will need educated on the label and SDS changes due to the updated product classifications, pictograms, signal words and precautionary statements. Written programs will need updated to include changes to labeling, SDS communication and employee training.	OSHA has stated that employers will be required to train employees within 2 years of the publication of the final rule. Training employees and updating the written program will require significant resources and should occur as soon as your organization begins its GHS transition.

More on the Revised Hazard Communication Standard

"Exposure to hazardous chemicals is one of the most serious threats facing American workers today," said U.S. Secretary of Labor Hilda Solis. "Revising OSHA's Hazard Communication standard will improve the quality and consistency of hazard information, making it safer for workers to do their jobs and easier for employers to stay competitive." The Hazard Communication Standard (HCS) is now aligned with the Globally Harmonized System of Classification and Labeling of Chemicals (GHS).

This update to the Hazard Communication Standard (HCS) will provide a common and coherent approach to classifying chemicals and communicating hazard information on labels and safety data sheets.

Once implemented, the revised standard will improve the quality and consistency of hazard information in the workplace, making it safer for workers by providing easily understandable information on appropriate handling and safe use of hazardous chemicals.

This update will also help reduce trade barriers and result in productivity improvements for American businesses that regularly handle, store, and use hazardous chemicals while providing cost savings for American businesses that periodically update safety data sheets and labels for chemicals covered under the hazard communication standard.

Rationale
In order to ensure chemical safety in the workplace, information about the identities and hazards of the chemicals must be available and understandable to workers. OSHA's Hazard Communication Standard (HCS) requires the development and dissemination of such information:

- Chemical manufacturers and importers are required to evaluate the hazards of the chemicals they produce or import, and prepare labels and safety data sheets to convey the hazard information to their downstream customers;
- All employers with hazardous chemicals in their workplaces must have labels and safety data sheets for their exposed workers, and train them to handle the chemicals appropriately.

Major changes to the Hazard Communication Standard
Hazard classification: Provides specific criteria for classification of health and physical hazards, as well as classification of mixtures.

Labels: Chemical manufacturers and importers will be required to provide a label that includes a harmonized signal word, pictogram, and hazard statement for each hazard class and category. Precautionary statements must also be provided.

Safety Data Sheets: Will now have a specified 16-section format.
Information and training: Employers are required to train workers by December 1, 2013 on the new labels elements and safety data sheets format to facilitate recognition and understanding.

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

What is the Globally Harmonized System?

The Globally Harmonized System (GHS) is an international approach to hazard communication, providing agreed criteria for classification of chemical hazards, and a standardized approach to label elements and safety data sheets. The GHS was negotiated in a multi-year process by hazard communication experts from many different countries, international organizations, and stakeholder groups. It is based on major existing systems around the world, including OSHA's Hazard Communication Standard and the chemical classification and labeling systems of other US agencies.

The result of this negotiation process is the United Nations' document entitled "Globally Harmonized System of Classification and Labeling of Chemicals," commonly referred to as The Purple Book. This document provides harmonized classification criteria for health, physical, and environmental hazards of chemicals. It also includes standardized label elements that are assigned to these hazard classes and categories, and provide the appropriate signal words, pictograms, and hazard and precautionary statements to convey the hazards to users. A standardized order of information for safety data sheets is also provided. These recommendations can be used by regulatory authorities such as OSHA to establish mandatory requirements for hazard communication, but do not constitute a model regulation.

Why did OSHA decide to modify the Hazard Communication Standard to adopt the GHS?

OSHA has modified the Hazard Communication Standard (HCS) to adopt the GHS to improve safety and health of workers through more effective communications on chemical hazards. Since it was first promulgated in 1983, the HCS has provided employers and employees extensive information about the chemicals in their workplaces. The original standard is performance-oriented, allowing chemical manufacturers and importers to convey information on labels and material safety data sheets in whatever format they choose. While the available information has been helpful in improving employee safety and health, a more standardized approach to classifying the hazards and conveying the information will be more effective, and provide further improvements in American workplaces. The GHS provides such a standardized approach, including detailed criteria for determining what hazardous effects a chemical poses, as well as standardized label elements assigned by hazard class and category.

This will enhance both employer and worker comprehension of the hazards, which will help to ensure appropriate handling and safe use of workplace chemicals. In addition, the safety data sheet requirements establish an order of information that is standardized. The harmonized format of the safety data sheets will enable employers, workers, health professionals, and emergency responders to access the information more efficiently and effectively, thus increasing their utility.

Adoption of the GHS in the US and around the world will also help to improve information received from other countries—since the US is both a major importer and exporter of chemicals, American workers often see labels and safety data sheets from other countries. The diverse and sometimes conflicting national and international requirements can create confusion among those who seek to use hazard information effectively.

For example, labels and safety data sheets may include symbols and hazard statements that are unfamiliar to readers or not well understood. Containers may be labeled with such a large volume of information that important statements are not easily recognized. Given the differences in hazard classification criteria, labels may also be incorrect when used in other countries.

If countries around the world adopt the GHS, these problems will be minimized, and chemicals crossing borders will have consistent information, thus improving communication globally.

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

What is the phase-in period in the revised Hazard Communication Standard?
The table below summarizes the phase-in dates required under the revised Hazard Communication Standard (HCS):

Effective Completion Date	Requirement(s)	Who
December 1, 2013	Train employees on the new label elements and safety data sheet (SDS) format.	Employers
June 1, 2015* December 1, 2015	Compliance with all modified provisions of this final rule, except: The Distributor shall not ship containers labeled by the chemical manufacturer or importer unless it is a GHS label	Chemical manufacturers, importers, distributors and employers
June 1, 2016	Update alternative workplace labeling and hazard communication program as necessary, and provide additional employee training for newly identified physical or health hazards.	Employers
Transition Period to the effective completion dates noted above	May comply with either 29 CFR 1910.1200 (the final standard), or the current standard, or both	Chemical manufacturers, importers, distributors, and employers

*This date coincides with the EU implementation date for classification of mixtures.

During the phase-in period, employers would be required to be in compliance with either the existing HCS or the revised HCS, or both. OSHA recognizes that hazard communication programs will go through a period of time where labels and SDSs under both standards will be present in the workplace. This will be considered acceptable, and employers are not required to maintain two sets of labels and SDSs for compliance purposes.

Why must training be conducted prior to the compliance effective date?
OSHA is requiring that employees are trained on the new label elements (e.g., pictograms and signal words) and SDS format by December 2013, while full compliance with the final rule will begin in 2015. While many countries are in various stages of implementing the GHS, OSHA believes that it is possible that American workplaces may begin to receive labels and SDSs that are consistent with the GHS shortly after publication.

Thus, making it important to ensure that when employees begin to see the new labels and SDSs in their workplaces, they will be familiar with them, understand how to use them, and access the information effectively.

What are the major changes to the Hazard Communication Standard?
The three major areas of change are in hazard classification, labels, and safety data sheets.

Hazard classification: The definitions of hazard have been changed to provide specific criteria for classification of health and physical hazards, as well as classification of mixtures. These specific criteria will help to ensure that evaluations of hazardous effects are consistent across manufacturers, and that labels and safety data sheets are more accurate as a result.

Labels: Chemical manufacturers and importers will be required to provide a label that includes a harmonized signal word, pictogram, and hazard statement for each hazard class and category. Precautionary statements must also be provided.

Safety Data Sheets: Will now have a specified 16-section format. The GHS does not include harmonized training provisions, but recognizes that training is essential to an effective hazard communication approach. The revised Hazard Communication Standard (HCS) requires that workers be re- trained within two years of the publication of the final rule to facilitate recognition and understanding of the new labels and safety data sheets.

For a side-by-side comparison of the current HCS and the final revised HCS please see OSHA's hazard communication safety and health topics webpage at: http://www.osha.gov/dsg/hazcom/index.html

What Hazard Communication Standard provisions are unchanged in the revised HCS?
The revised Hazard Communication Standard (HCS) is a modification to the existing standard. The parts of the standard that did not relate to the GHS (such as the basic framework, scope, and exemptions) remained largely unchanged. There have been some modifications to terminology in order to align the revised HCS with language used in the GHS. For example, the term "hazard determination" has been changed to "hazard classification" and "material safety data sheet" was changed to "safety data sheet." OSHA stakeholders commented on this approach and found it to be appropriate.

How will chemical hazard evaluation change under the revised Hazard Communication Standard?
Under both the current Hazard Communication Standard (HCS) and the revised HCS, an evaluation of chemical hazards must be performed considering the available scientific evidence concerning such hazards. Under the current HCS, the hazard determination provisions have definitions of hazard and the evaluator determines whether or not the data on a chemical meet those definitions. It is a performance-oriented approach that provides parameters for the evaluation, but not specific, detailed criteria.

The hazard classification approach in the revised HCS is quite different. The revised HCS has specific criteria for each health and physical hazard, along with detailed instructions for hazard evaluation and determinations as to whether mixtures or substances are covered. It also establishes both hazard classes and hazard categories—for most of the effects; the classes are divided into categories that reflect the relative severity of the effect.

United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS)

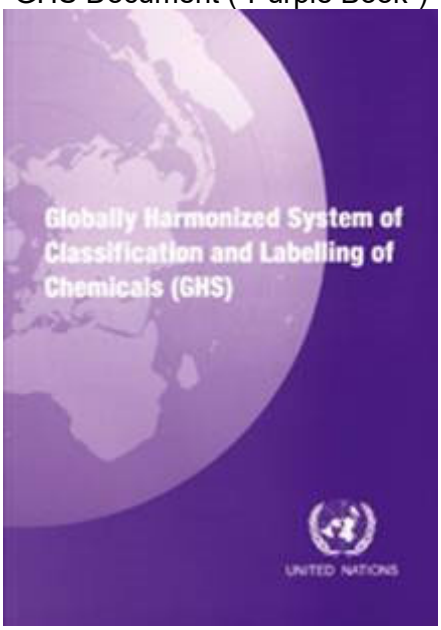
1.0 Background

The purpose of this document is to describe the United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS), why it was developed, and how it relates to the sound management of chemicals.

1.1 What is the GHS?

The GHS is an acronym for The Globally Harmonized System of Classification and Labeling of Chemicals. The GHS is a system for standardizing and harmonizing the classification and labeling of chemicals. It is a logical and comprehensive approach to:
Defining health, physical and environmental hazards of chemicals;
Creating classification processes that use available data on chemicals for comparison with the defined hazard criteria; and Communicating hazard information, as well as protective measures, on labels and Safety Data Sheets (SDS).

Figure 1.1
GHS Document ("Purple Book")



Many countries already have regulatory systems in place for these types of requirements. These systems may be similar in content and approach, but their differences are significant enough to require multiple classifications, labels and safety data sheets for the same product when marketed in different countries or even in the same country when parts of the life cycle are covered by different regulatory authorities. This leads to inconsistent protection for those potentially exposed to the chemicals, as well as creating extensive regulatory burdens on companies producing chemicals.

For example, in the United States (U.S.) there are requirements for classification and labeling of chemicals for the Consumer Product Safety Commission, the Department of Transportation, the Environmental Protection Agency, and the Occupational Safety and Health Administration.

The GHS itself is not a regulation or a standard. The GHS Document (referred to as "The Purple Book", shown in Figure 1.1) establishes agreed hazard classification and communication provisions with explanatory information on how to apply the system. The elements in the GHS supply a mechanism to meet the basic requirement of any hazard communication system, which is to decide if the chemical product produced and/or supplied is hazardous and to prepare a label and/or Safety Data Sheet as appropriate. Regulatory authorities in countries adopting the GHS will thus take the agreed criteria and provisions, and implement them through their own regulatory process and procedures rather than simply incorporating the text of the GHS into their national requirements.

The GHS Document thus provides countries with the regulatory building blocks to develop or modify existing national programs that address classification of hazards and transmittal of information about those hazards and associated protective measures. This helps to ensure the safe use of chemicals as they move through the product life cycle from "cradle to grave."

1.2 Why was the GHS developed?

The production and use of chemicals is fundamental to all economies. The global chemical business is more than a $1.7 trillion per year enterprise. In the U.S., chemicals are more than a $450 billion business and exports are greater than $80 billion per year.

Chemicals directly or indirectly affect our lives and are essential to our food, our health, and our lifestyle. The widespread use of chemicals has resulted in the development of sector-specific regulations (transport, production, workplace, agriculture, trade, and consumer products).

Having readily available information on the hazardous properties of chemicals, and recommended control measures, allows the production, transport, use and disposal of chemicals to be managed safely. Thus, human health and the environment are protected.

The sound management of chemicals should include systems through which chemical hazards are identified and communicated to all who are potentially exposed. These groups include workers, consumers, emergency responders and the public. It is important to know what chemicals are present and/or used, their hazards to human health and the environment, and the means to control them.

A number of classification and labeling systems, each addressing specific use patterns and groups of chemicals, exist at the national, regional and international levels. The existing hazard classification and labeling systems address potential exposure to chemicals in all the types of use settings listed above.

Acute oral toxicity LD50 (mg/kg)									
Organization/Country/ Regulation or Standard	High		Hazard				Low		
	0		< 50		< 500		< 5000		
ANSI/US/A 129.1	< 50 Highly Toxic		> 50 < 500 Toxic		> 500 < 2000 Harmful				
OSHA/US/HCS	< 50 Highly Toxic		> 50 < 500 Toxic						
EPA/US/FIFRA	0 ≤ 50 Toxicity Category I		> 50 ≤ 500 Toxicity Category II		> 500 < 5000 Toxic Category III		> 5000 Toxicity Category IV		
CPSC/US/FHSA	< 50 Highly Toxic		> 50 ≤ 500 Toxic						
GHS	≤ 5	> 5 ≤ 50	> 50 ≤ 300		> 300 ≤ 2000		> 2000 ≤ 5000		
DOT/US	< 5 Picking Group 1	> 5 < 50 Picking Group II	> 50 < 200 (solid) > 50 > 500 (liquid) Picking Group III						
NFPA/US	≤ 5 Hazard Category 4	> 5 ≤ 50 Hazard Category 3	> 50 ≤ 500 Hazard Category 2		> 500 ≤ 2000 Hazard Category 1		> 2000 Hazard Category 0		
NPCA/US/HMIS	≤ 1 Toxicity Rating 4	> 1 ≤ 50 Toxicity Rating 3	> 50 ≤ 500 Toxicity Rating 2		> 500 ≤ 5000 Toxicity Rating 1		> 5000 Toxicity Rating 0		
EU	< 25 Very Toxic	> 25 > 200 Toxic		> 200 < 2000 Harmful					
WHMIS/Canada	≤ 50 Very Toxic WHMIS Class D, Division 1, Subdivision A		> 50 ≤ 500 Toxic WHMIS Class D, Division 1, Subdivision B						
Australia/NOHSC	< 25 Very Toxic	> 25 < 200 Toxic		> 200 < 2000 Harmful					
Mexico	<1 Extremely Toxic	>20 < 50 Highly Toxic	> 50 < 500 Moderately Toxic		> 500 < 5000 Mildly Toxic				
Malaysia	< 25 Very Toxic		200 to 500 Harmful						

Japan	< 30 Poisonous			300 to 3000 Powerful	
Korea	< 25 Very Toxic	> 50 < 200 Toxic	> 200 < 2000 Harmful		

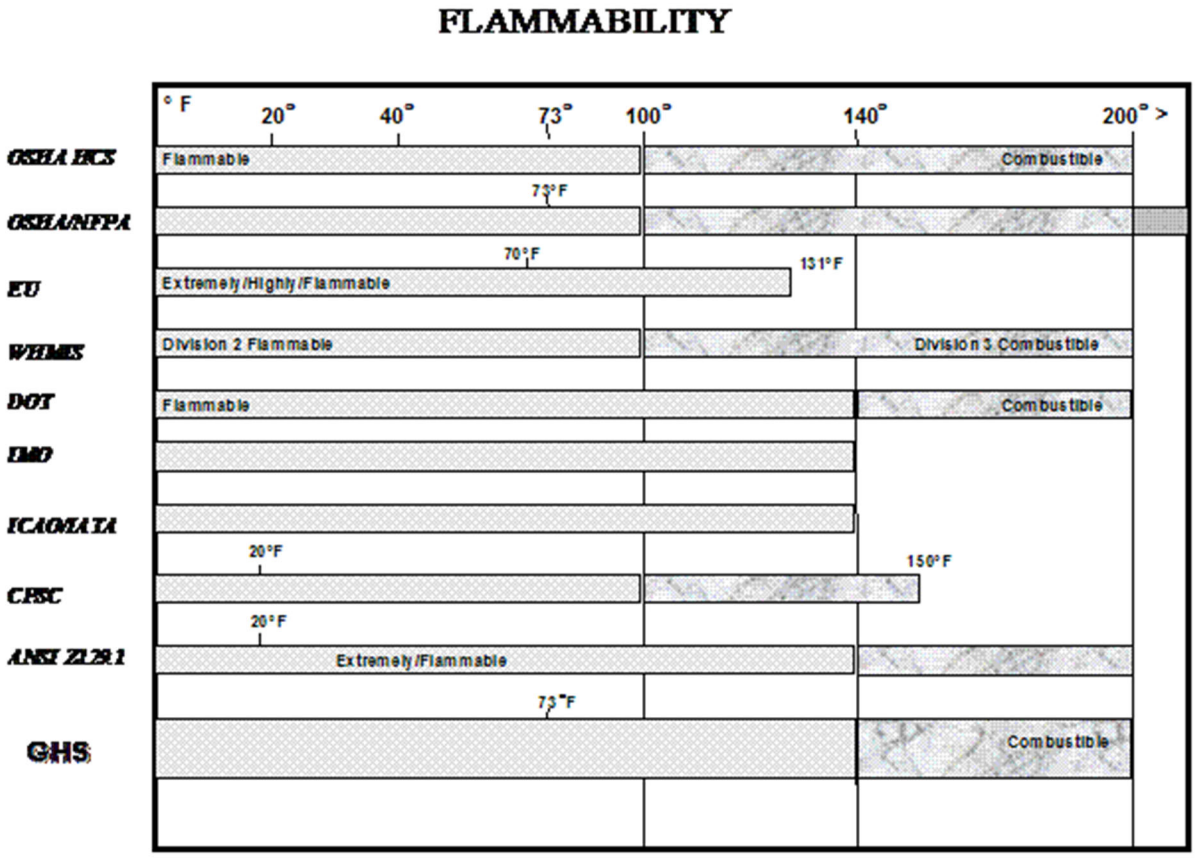
Figure 1.2
The numerical values on the hazard index scale in the table are not to scale.

For example, a product may be considered flammable or toxic by one agency or country, but not by another.

We can see by comparing a few hazards how complex it is to comply with all domestic and global regulations. Acute oral toxicity (LD50) is a good example (Figure 1.2). Although most existing systems cover acute toxicity, we can see in the figure that what is considered hazardous varies considerably. These differences allow the same product to be hazardous in one country/system and not in another. At the very least, the same product has different labels and SDSs.

While the existing laws and regulations are similar, they are different enough to require multiple labels for the same product both within the U.S. and in international trade and to require multiple safety data sheets for the same product in international trade. Several U.S. regulatory agencies and various countries have different requirements for hazard definitions as well as for information to be included on labels or material safety data sheets.

Figure 1.3



The numerical values on the hazard index scale in the table are not to scale.

Text Version of Chart:

Title: FLAMMABILITY
Type: Bar line graph by Fahrenheit degree from 0 degrees to 200 degrees with ten chart segments.

Chart data:
OSHA HCS
Flammable = 0-100 Degrees
Combustible = 100-200 degrees
OSHA/NFPA
Flammable = 0-100 Degrees
Combustible = 100-200+ degrees
EU
Extremely/Highly/Flammable = 0-131 Degrees
WHMIS
Division 2 Flammable = 0-100 Degrees
Division 3 Combustible = 100-200 degrees
DOT
Flammable = 0-140 Degrees
Combustible = 140-200 degrees
IMO

Flammable = 0-140 Degrees
ICAO/IATA
Flammable = 0-140 Degrees
CPSC
Flammable = 0-100 Degrees
Combustible = 100-150 degrees
ANSI Z129.1
Extremely Flammable = 0-140 Degrees
Combustible = 140-200 degrees
GHS
Flammable = 0-140 Degrees
Combustible = 140-200 degrees

Flammable liquid is another hazard that is covered by most existing systems. As shown in Figure 1.3, the coverage varies between existing systems within the U.S. and globally. This means that the same product can be non-hazardous or hazardous with different labels/SDSs. In Section 4, Figures 4.1 through 4.7 show the diverse domestic and international labels for a fictitious product (ToxiFlam) which has both oral toxicity and flammability hazards.

These differences in hazards and SDS/labels impact both protection and trade. In the area of protection, users may see different label warnings or safety data sheet information for the same chemical. In the area of trade, the need to comply with multiple regulations regarding hazard classification and labeling is costly and time-consuming.

Some multinational companies have estimated that there are over 100 diverse hazard communication regulations for their products globally. For small and medium size enterprises (SMEs) regulatory compliance is complex and costly, and it can act as a barrier to international trade in chemicals.

1.3 What was the International Mandate?

Figure 1.4

International mandate from UNCED Agenda 21, Chapter 19

"A globally harmonized hazard classification and compatible labeling system, including material safety data sheets and easily understandable symbols, should be available, if feasible, by the year 2000."

The single most important force that drove the creation of the GHS was the international mandate (Figure 1.4) adopted in the 1992 United Nations Conference on Environment and Development (UNCED), often called the "Earth Summit".

1.4 How was the GHS developed?
In conjunction with its Convention and Recommendation on Safety in the Use of Chemicals at Work, the International Labor Organization (ILO) studied the tasks required to achieve harmonization. The ILO concluded that there were four major existing systems that needed to be harmonized to achieve a global approach.

No international organization covers all aspects of chemical classification and labeling. A broad scope and extensive expertise and resources were required to develop a system. In order to proceed, several decisions were needed:

(a) what systems would be considered "major" and thus the basis for harmonization, and (b) how could the work be divided to get the best expertise for different aspects. Four existing systems (Figure #1.5) were deemed to be major and the primary basis for the GHS. While not considered major, requirements of other systems were examined as appropriate, and taken into account as proposals were developed.

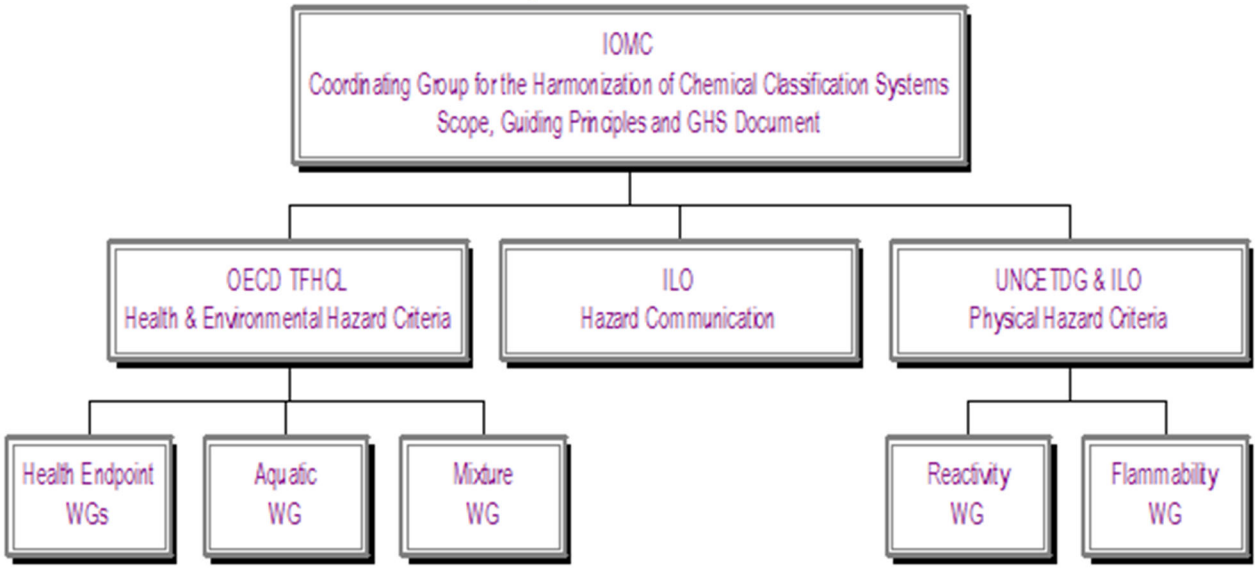
Figure 1.5
Existing Systems Included in the Harmonization Process
UN Transport Recommendations
U.S. Requirements for Workplace, Consumer and Pesticides
European Union Dangerous Substance and Preparations Directives
Canadian Requirements for Workplace, Consumers and Pesticides

A Coordinating Group for the Harmonization of Chemical Classification Systems (CG/HCCS) was created under the Inter-organization Program for the Sound Management of Chemicals (IOMC) and they were charged with coordinating and managing development of the system. The GC/HCCS worked on a consensus basis and included representatives from major stakeholders, including national governments, industry and workers. They created a set of guiding principles (Figure 1.6). The scope and guiding principles created a common framework for the organizations that were charged with developing the different elements of the system.

Figure 1.6
Key Guiding Principles of the Harmonization Process
- ✓ Protection will not be reduced
- ✓ Will be based on intrinsic properties (hazards) of chemicals
- ✓ All types of chemicals will be covered
- ✓ All systems will have to be changed
- ✓ Involvement of all stakeholders should be ensured
- ✓ Comprehensibility must be addressed

In order to get the best expertise and resources, the work was divided among three technical focal points. Figure 1.7 shows how the work was assigned to the three technical focal points and the overall responsibilities of the Coordinating Group itself.
The UN Committee of Experts on Transport of Dangerous Goods was selected as the lead for work on physical hazards, in cooperation with the ILO. Based on their work in the testing guidelines and other chemical issues, the Organization for Economic Cooperation and Development (OECD) was selected for health/environmental hazards and mixtures. ILO has a long history in MSDS/labels, and was selected to be the lead in hazard communication. The OECD and ILO groups also included representatives from governments, industry and workers.

Figure 1.7



Text Version of Flowchart:

IOMC
Coordinating Group for the Harmonization of Chemical Classification Systems
Scope, Guiding Principles and GHS Document

OECD TFHCL Health & Environmental Hazard Criteria	ILO Hazard Communication	UNCE TDG & ILO Physical Hazard Criteria

Health Endpoint WGs	Aquatic WGs	Mixture WGs	Reactivity WGs	Flammability WGs

1.5 How will the GHS be maintained and updated?
In October 1999, the United Nations Economic and Social Council decided (resolution 1999/65) to enlarge the mandate of the Committee of Experts on the Transport of Dangerous Goods by reconfiguring it into a Committee of Experts on the Transport of Dangerous Goods and on the Globally Harmonized System of Classification and labeling of Chemicals (UNCETDG/GHS). At the same time, a new Sub-Committee of Experts on the Globally Harmonized System of Classification and labeling of Chemicals (GHS Sub-Committee) was also created.

When the IOMC completed developing the GHS, the system was presented to the UN GHS Sub-Committee, which formally adopted the system at its first session in December 2002. It was subsequently endorsed by the UNCETDG/GHS. The UN Economic and Social Council endorsed the GHS in July 2003.

The Sub-Committee of Experts on the Globally Harmonized System of Classification will:

- ✓ Act as custodian of the system, managing and giving direction to the harmonization process,
- ✓ Keep the system up-to-date, as necessary, considering the need to introduce changes or updates to ensure its continued relevance,
- ✓ Promote understanding and use of the system and encourage feedback,
- ✓ Make the system available for worldwide use,
- ✓ Make guidance available on the application of the system, and on the interpretation and use of technical criteria to support consistency of application,
- ✓ Prepare work programs and submit recommendations to the UNCETDG/GHS.

1.6 When will the GHS be implemented?
There is no international implementation schedule for the GHS. It is likely that different national systems/sectors will require different timeframes for GHS implementation. Existing systems will need to consider phase-in strategies for transition from their current requirements to the new GHS requirements.

Several international bodies have proposed implementation goals. The World Summit on Sustainable Development (WSSD) and the Intergovernmental Forum for Chemical Safety (IFCS) have encouraged countries to implement the new GHS as soon as possible with a view to having the system fully operational by 2008.

The Ministers of the Asia-Pacific Economic Cooperation (APEC) have also said that as many APEC economies as possible should implement, on a voluntary basis, the GHS by 2006. Under the North American Free Trade Agreement (NAFTA), the Tri-national Occupational Safety and Health Group and the NAFTA Pesticides Technical Working Group are discussing the GHS.

Some of the major existing systems have begun discussions about GHS implementation and situational analyses comparing existing requirements to GHS requirements. Some countries are considering harmonization to the greatest extent possible between their national sectors.

1.7 What are the benefits?

The basic goal of hazard communication is to ensure that employers, employees and the public are provided with adequate, practical, reliable and comprehensible information on the hazards of chemicals, so that they can take effective preventive and protective measure for their health and safety. Thus, implementation of effective hazard communication provides benefits for governments, companies, workers, and members of the public.

The GHS has maximum value if it is accepted in all major regulatory systems for chemical hazard communication. The diversity of hazard definitions is shown in Figures 1.2 and 1.3. The array of domestic and global labels for one product is shown in Figures 4.1 to 4.7. In the USA implementation of the GHS would harmonize hazard definitions and label information among U.S. regulatory agencies (CPSC, DOT, EPA, OSHA, etc.). If the GHS is implemented globally, consistent information will be communicated on labels and SDSs.

It is anticipated that application of the GHS will:

- ✓ Enhance the protection of human health and the environment by providing an internationally comprehensible system,
- ✓ Provide a recognized framework to develop regulations for those countries without existing systems,
- ✓ Facilitate international trade in chemicals whose hazards have been identified on an international basis,
- ✓ Reduce the need for testing and evaluation against multiple classification systems.

The tangible benefits to governments are:

- ✓ Fewer chemical accidents and incidents,
- ✓ Lower health care costs,
- ✓ Improved protection of workers and the public from chemical hazards,
- ✓ Avoiding duplication of effort in creating national systems,
- ✓ Reduction in the costs of enforcement,
- ✓ Improved reputation on chemical issues, both domestically and internationally.

Benefits to companies include:

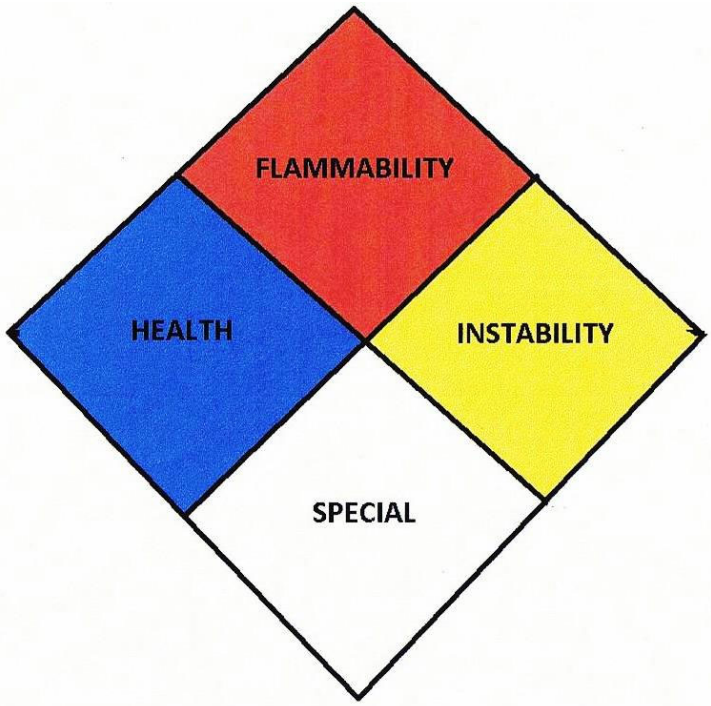
- ✓ A safer work environment and improved relations with employees,
- ✓ An increase in efficiency and reduced costs from compliance with hazard communication regulations,
- ✓ Application of expert systems resulting in maximizing expert resources and minimizing labor and costs,
- ✓ Facilitation of electronic transmission systems with international scope,
- ✓ Expanded use of training programs on health and safety,
- ✓ Reduced costs due to fewer accidents and illnesses,
- ✓ Improved corporate image and credibility.

Benefits to workers and members of the public include:

- ✓ Improved safety for workers and others through consistent and simplified communications on chemical hazards and practices to follow for safe handling and use,
- ✓ Greater awareness of hazards, resulting in safer use of chemicals in the workplace and in the home.

2.0 How is the GHS to be applied?

The GHS Classification and Communication elements are the foundation of programs to ensure the safe use of chemicals, as shown in Figure 2.1. The first two steps in any program to ensure the safe use of chemicals are to identify intrinsic hazard(s) (i.e., classification) and then to communicate that information. The design of the GHS communication elements reflects the different needs of various target audiences, such as workers and consumers.

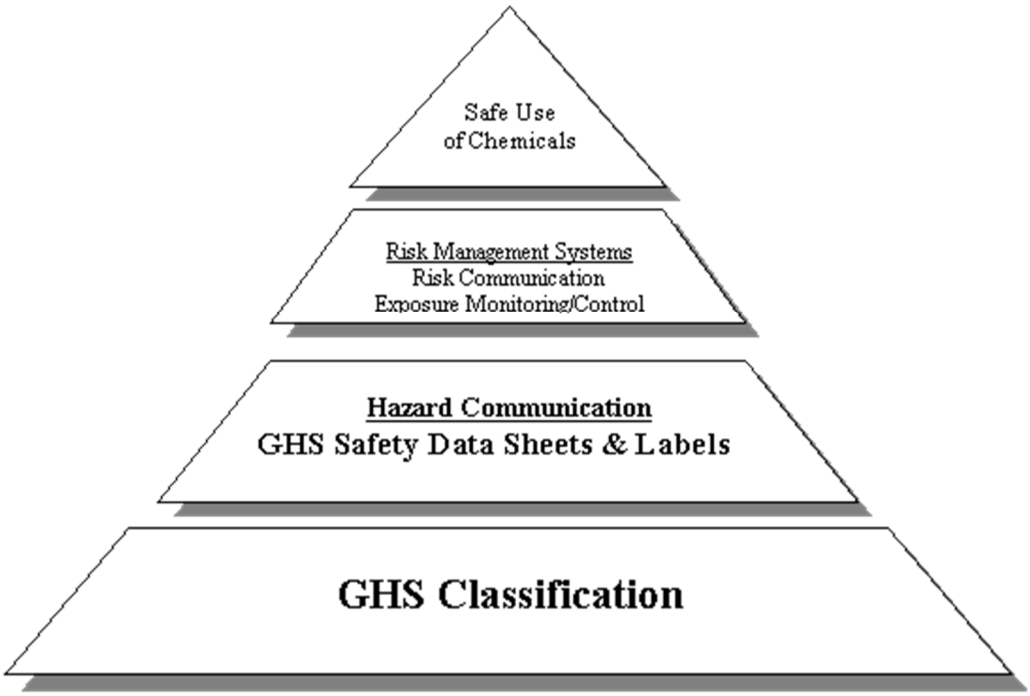


NFPA FIRE DIAMOND

To proceed further up the pyramid, some existing national programs also include risk management systems as part of an overall program on the sound management of chemicals. The general goal of these systems is to minimize exposure, resulting in reduced risk. The systems vary in focus and include activities such as establishing exposure limits, recommending exposure monitoring methods and creating engineering controls.

However, the target audiences of such systems are generally limited to workplace settings. With or without formal risk management systems, the GHS is designed to promote the safe use of chemicals.

Figure 2.1



2.1 Are all chemicals covered by the GHS?

The GHS covers all hazardous chemicals. There are no complete exemptions from the scope of the GHS for a particular type of chemical or product. The term "chemical" is used broadly to include substances, products, mixtures, preparations, or any other terms that may be used by existing systems. The goal of the GHS is to identify the intrinsic hazards of chemical substances and mixtures and to convey hazard information about these hazards. The GHS is not intended to harmonize risk assessment procedures or risk management decisions, as described above.

"Articles" as defined in the OSHA Hazard Communication Standard (HCS) (29 CFR 1910.1200), or by similar definitions, are outside the scope of the GHS. Chemical inventory (e.g., TSCA, EINECS, etc.) and chemical control requirements in various countries are not harmonized by the GHS. Classification in the GHS is criteria-based, not limiting coverage to a list that can become outdated. It is not anticipated that the GHS will develop or maintain an international classification authority or international classification list. Several countries currently maintain regulatory lists. GHS classification criteria can be used to reclassify chemicals on lists, if desired. Existing lists, such as those provide by organizations that evaluate cancer hazards, could be used in conjunction with the GHS to promote harmonization.

The harmonization of classification and labeling of chemicals was one of six program areas that were endorsed by the United Nations General Assembly to strengthen international efforts concerning the environmentally sound management of chemicals. It was recognized that an internationally harmonized approach to classification and labeling would provide the foundation for all countries to develop comprehensive national programs to ensure the safe use of chemicals.

2.2 Will all hazardous chemicals require a GHS label and Safety Data Sheet?

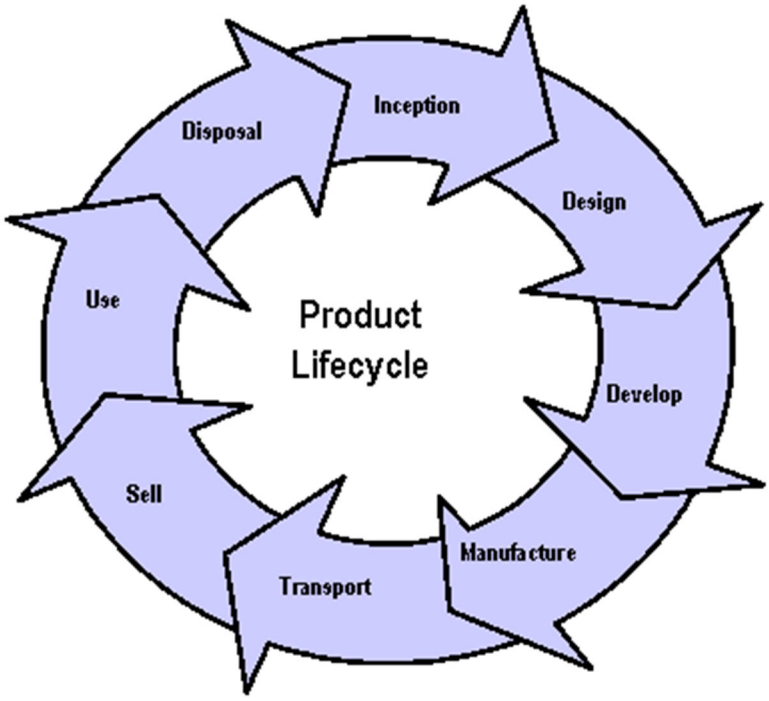


Figure 2.2

The need for GHS labels and/or Safety Data Sheets is expected to vary by product category or stage in the chemical's lifecycle from research/production to end use. The sequence of lifecycle events is shown in Figure 2.2. For example, pharmaceuticals, food additives, cosmetics and pesticide residues in food will not be covered by the GHS at the point of consumption, but will be covered where workers may be exposed (workplaces), and in transport.

Also, the medical use of human or veterinary pharmaceuticals is generally addressed in package inserts and is not part of existing hazard communication systems.

Similarly, foods are generally not labeled under existing hazard communication systems. The exact requirements for labels and Safety Data Sheets will continue to be defined in national regulations.

However, national requirements are expected to be consistent with the detailed discussion of scope provided in Chapter 1.1 of the GHS document.

2.3 How will the GHS impact existing regulations?

The GHS is a voluntary international system that imposes no binding treaty obligations on countries. To the extent that countries adopt the GHS into their systems, the regulatory changes would be binding for covered industries. For countries with existing systems, it is expected that the GHS components will be applied within the framework/infrastructure of existing hazard communication regulatory schemes. For example, exceptions and exemptions found in existing regulations would not be expected to change (e.g., transportation of limited quantities).

However, the specific hazard criteria, classification processes, label elements and SDS requirements within an existing regulation will need to be modified to be consistent with the harmonized elements of the GHS. It is anticipated that ALL existing hazard communication systems will need to be changed in order to apply the GHS. For example, in the U.S. EPA and OSHA would be expected to require hazard pictograms/symbols on labels. Canada and the EU would be expected to adopt the GHS pictograms/symbols instead of those currently in use. The transport sector is expected to adopt the changed criteria (LD50/LC50) for the GHS Acute Toxicity Categories 1 - 3. OSHA HCS, WHMIS and the EU would all need to change their acute toxicity criteria.

Test data already generated for the classification of chemicals under existing systems should be accepted when classifying these chemicals under the GHS, thereby avoiding duplicative testing and the unnecessary use of test animals.

2.4 What is meant by GHS Building Blocks?

The GHS classification and communication requirements can be thought of as a collection of building blocks. In regulatory schemes, coverage and communication of hazards vary by the needs of target audiences/sectors. Accordingly, the GHS was designed to contain the hazard endpoints and communication tools necessary for application to known regulatory schemes. The GHS is structured so that the appropriate elements for classification and communication, which address the target audiences, can be selected.

The full range of harmonized elements is available to everyone, and should be used if a country or organization chooses to cover a certain effect when it adopts the GHS. The full range of these elements does not have to be adopted. Countries can determine which of the building blocks will be applied in different parts of their systems (consumer, workplace, transport, pesticides, etc.). For example, some options for implementing the GHS include:

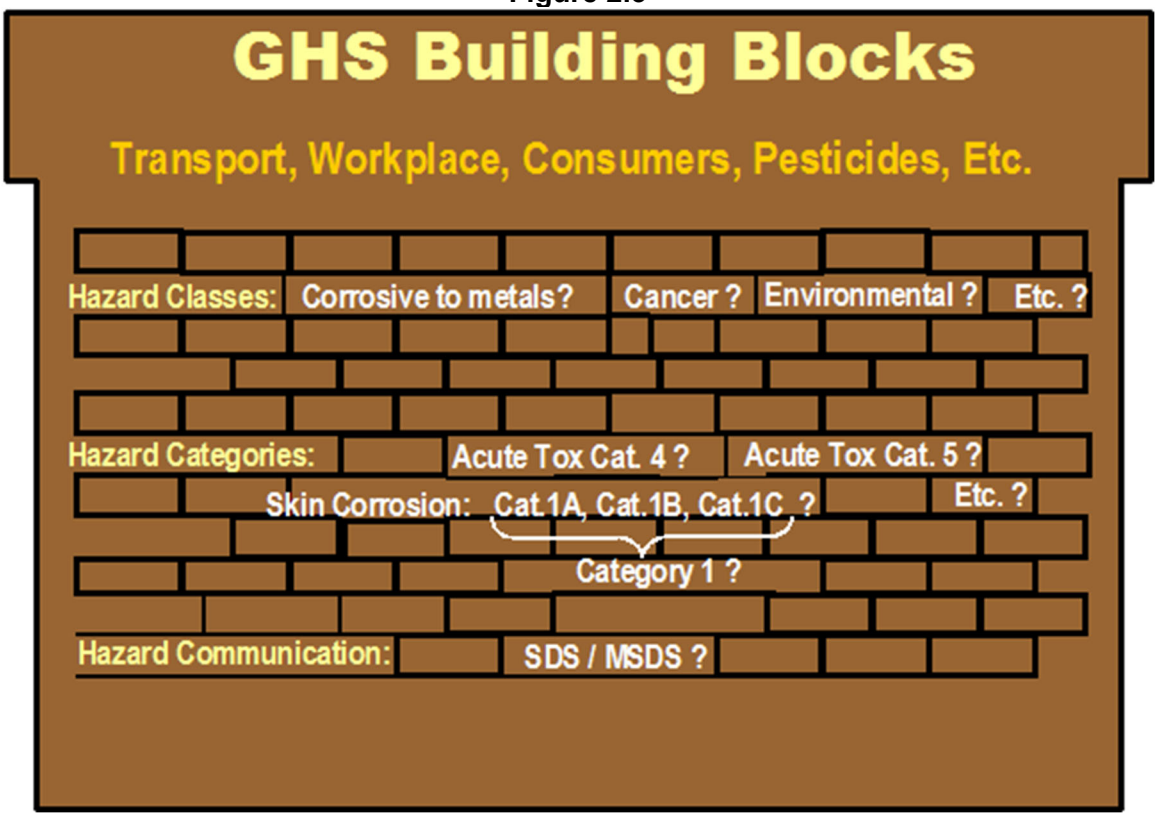
- ✓ Not using a GHS class (e.g., cancer, hazardous to the aquatic environment, etc.);
- ✓ Not using a GHS category (normally at the beginning or end of a class, e.g., Acute Toxicity Cat. 5);
- ✓ Combining categories (e.g., Acute Toxicity Cat.# 1 and Cat.# 2; Skin Corrosion Cat.1A, 1B and 1C).

2.5 How should the GHS Building Blocks by applied?

Appropriate implementation of the GHS means that the hazards covered by a Competent Authority (CA) are covered consistently with the GHS criteria and requirements. The EPA, Health Canada and OSHA are examples of Competent Authorities. Competent Authorities will decide how to apply the various elements of the GHS based on the CA needs and the needs of target audiences.

When a regulatory scheme covers something that is in the GHS, and implements the GHS, that coverage should be consistent. Once an endpoint and subclasses are selected, as needed, the GHS classification criteria, assigned label elements and SDS provisions should be followed as specified in the GHS. If a regulatory system covers carcinogenicity, for example, it should follow the harmonized classification scheme, the harmonized label elements and, where appropriate, the SDS. Figure 2.3 shows some of the hazard endpoint/subcategory and hazard communication building block choices for the transport, workplace, consumer and pesticide sectors.

Figure 2.3



To gain a better understanding of the building block approach, it is helpful to look at the specific sectors/target audiences. The needs and regulations of the various sectors vary depending on the type of chemical and use pattern. Different target audiences or sectors receive and use hazard information in different ways.

The primary sectors/target audiences are transport, workplace, consumers and agriculture (pesticides). These sectors are described in more detail below.

2.5.1 Transport

For transport, it is expected that application of the GHS will be similar to application of current transport requirements.
GHS physical, acute and environmental hazard criteria are expected to be adopted in the transport sector.
Containers of dangerous goods will have pictograms that address acute toxicity, physical hazards, and environmental hazards.
GHS hazard communication elements such as signal words, hazard statements and SDS are not expected to be adopted in the transport sector.

2.5.2 Workplace

In the workplace, it is expected that most of the GHS elements will be adopted, including;·

- ✓ GHS physical and health hazard criteria, as appropriate;
- ✓ Labels that have the harmonized core information under the GHS (signal words, hazard statements and symbols, etc.);
- ✓ Safety Data Sheets;
- ✓ Employee training to help ensure effective communication is also anticipated;
- ✓ All workplace systems may not have the jurisdiction to adopt environmental hazards.

2.5.3 Consumer

For the consumer sector, it is expected that labels will be the primary focus of GHS application.·

The appropriate GHS hazard criteria are expected to be adopted;

These labels will include the core elements of the GHS (signal words, hazard statements and symbols, etc.), subject to some sector-specific considerations in certain systems (e.g., risk-based labeling).

2.5.4 Pesticides

For pesticides, it is expected that the GHS will be adopted.

The appropriate GHS hazard criteria are expected to be adopted;

Pesticide labels will include the core elements of the GHS (signal words, hazard statements and symbols, etc.), subject to some sector-specific considerations in certain systems.

2.6 How will the GHS impact countries without existing regulations?
Developing and maintaining a classification and labeling system is not a simple task. The GHS can be used as a tool for developing national regulations. It is expected that countries that do not have systems will adopt GHS as their basic scheme. The GHS provides the building blocks from which countries can construct chemical safety programs. Although the GHS will facilitate the process, many challenges exist in creating new regulations.

For example:
What is the appropriate legal framework for adopting/implementing the GHS?

What government agencies should be involved? Are there ministries/agencies ready to implement and maintain the GHS?

How will stakeholder cooperation and support for implementing the GHS be managed?
Work has begun in international organizations (e.g., UNITAR and ILO) under the guidance of the UN GHS Sub-Committee, to develop technical assistance for developing countries to write new regulations using the GHS elements. Guidance has been developed on how to implement a national GHS action plan. Additionally, pilot implementations have begun in a few countries.

The opportunities and challenges learned from the pilot programs will be documented and are expected to facilitate future implementations.

3.0 What is Classification?
Classification is the starting point for hazard communication. It involves the identification of the hazard(s) of a chemical or mixture by assigning a category of hazard/danger using defined criteria.

The GHS is designed to be consistent and transparent. It draws a clear distinction between classes and categories in order to allow for "self-classification".

For many hazards a decision tree approach (e.g., eye irritation) is provided in the GHS Document. For several hazards the GHS criteria are semi-quantitative or qualitative. Expert judgment may be required to interpret these data.

Figure 3.1
Hazard Classification

The term "hazard classification is used to indicate that only the intrinsic hazardous properties of substances and mixtures are considered and involves the following 3 steps:

a) Identification of relevant data regarding the hazards of a substance or mixture;
b) Subsequent review of those data to ascertain the hazards associated with the substance or mixture; and
c) A decision on whether the substance or mixture will be classified as a hazardous substance or mixture and the degree of hazard, where appropriate, by comparison of the data with agreed hazard classification criteria.

Figure 3.1 shows the harmonized definition for hazard classification, which can be applied to all hazard categories in the system.

The data used for classification may be obtained from tests, literature, and practical experience. The GHS health and environmental hazard criteria/definitions are test method neutral. Accordingly, tests that determine hazardous properties conducted according to internationally recognized scientific principles can be used for purposes of hazard classification.

The GHS endpoints that cover physical, health and environmental hazards are listed in Figures 3.2 and 3.3, respectively. As mentioned earlier, the GHS hazard definitions are criteria-based. The following information provides an overview of the GHS definitions and classification criteria. It is recommended that the person responsible for GHS implementation consult the GHS Document or "Purple Book" for more complete information.

3.1 What are the GHS Physical Hazards?

The GHS physical hazards criteria, developed by the ILO and UNCETDG, were largely based on the existing criteria used by the UN Model Regulation on the Transport of Dangerous Goods. Therefore, many of the criteria are already being used on a worldwide basis. However, some additions and changes were necessary since the scope of the GHS includes all target audiences. The physical hazards classification process provides specific references to approved test methods and criteria for classification. The GHS physical hazard criteria apply to mixtures. It is assumed that mixtures will be tested for physical hazards.

In general, the GHS criteria for physical hazards are quantitative or semi-quantitative with multiple hazard levels within an endpoint. This is different from several of the existing systems that currently have qualitative criteria for various physical hazards (e.g., organic peroxide criteria under WHMIS and OSHA HCS). This could make classification under the GHS more consistent.

In developing GHS criteria for physical hazards it was necessary to define physical states. In the GHS, a gas is a substance or mixture which at 50°C has a vapor pressure greater than 300 kPa; or is completely gaseous at 20°C and a standard pressure of 101.3 kPa. a liquid is a substance or mixture that is not a gas and which has a melting point or initial melting point of 20°C or less at standard pressure of 101.3 kPa. a solid is a substance or mixture that does not meet the definitions of a liquid or a gas.

The GHS physical hazards are briefly described below. For many of the physical hazards the GHS Document contains Guidance Sections with practical information to assist in applying the criteria.

Figure 3.2
Physical Hazard
Explosives
Flammable Gases
Flammable Aerosols
Oxidizing Gases
Gases Under Pressure
Flammable Liquids
Flammable Solids
Self-Reactive Substances
Pyrophoric Liquids
Pyrophoric Solids
Self-Heating Substances
Substances which, in contact
with water emit flammable gases
Oxidizing Liquids
Oxidizing Solids
Organic Peroxides
Corrosive to Metals

3.1.1 Explosives

An explosive substance (or mixture) is a solid or liquid which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. Pyrotechnic substances are included even when they do not evolve gases. A pyrotechnic substance (or mixture) is designed to produce an effect by heat, light, sound, gas or smoke or a combination of these as the result of non-detonative, self-sustaining, exothermic chemical reactions.

Classification as an explosive and allocation to a division is a three-step process:
Ascertain if the material has explosive effects (Test Series 1);
Acceptance procedure (Test Series 2 to 4);
Assignment to one of six hazard divisions (Test Series 5 to 7).

Table 3.1 Explosives

Division	Characteristics
1.1	Mass explosion hazard
1.2	Projection hazard
1.3	Fire hazard or minor projection hazard
1.4	No significant hazard
1.5	Very insensitive substances with mass explosion hazard
1.6	Extremely insensitive articles with no mass explosion hazard

Explosive properties are associated with certain chemical groups that can react to give very rapid increases in temperature or pressure.

The GHS provides a screening procedure that is aimed at identifying the presence of such reactive groups and the potential for rapid energy release. If the screening procedure identifies the substance or mixture to be a potential explosive, the acceptance procedure has to be performed.

Substances, mixtures and articles are assigned to one of six divisions, 1.1 to 1.6, depending on the type of hazard they present.

See, UN Manual of Tests and Criteria Part I Test Series 2 to 7. Currently, only the transport sector uses six categories for explosives.

3.1.2 Flammable Gases

Flammable gas means a gas having a flammable range in air at 20°C and a standard pressure of 101.3 kPa. Substances and mixtures of this hazard class are assigned to one of two hazard categories on the basis of the outcome of the test or calculation method (ISO 10156:1996).

3.1.3 Flammable Aerosols

Aerosols are any gas compressed, liquefied or dissolved under pressure within a non-refillable container made of metal, glass or plastic, with or without a liquid, paste or powder. The container is fitted with a release device allowing the contents to be ejected as solid or liquid particles in suspension in a gas, as a foam, paste or powder or in a liquid or gaseous state.

Aerosols should be considered for classification as either a Category 1 or Category 2 Flammable Aerosol if they contain any component classified as flammable according to the GHS criteria for flammable liquids, flammable gases, or flammable solids.

Classification is based on:

- ✓ Concentration of flammable components;
- ✓ Chemical heat of combustion (mainly for transport/storage);
- ✓ Results from the foam test (foam aerosols) (mainly for worker/consumer);
- ✓ Ignition distance test (spray aerosols) (mainly for worker/consumer);
- ✓ Enclosed space test (spray aerosols) (mainly for worker/consumer).

Aerosols are considered:
Nonflammable, if the concentration of the flammable components < 1% and the heat of combustion is < 20 kJ/g.

Extremely flammable, if the concentration of the flammable components >85% and the heat of combustion is > 30 kJ/g to avoid excessive testing. See the UN Manual of Tests and Criteria for the test method.

3.1.4 Oxidizing Gases

Oxidizing gas means any gas which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does. Substances and mixtures of this hazard class are assigned to a single hazard category on the basis that, generally by providing oxygen, they cause or contribute to the combustion of other material more than air does. The test method is ISO 10156:1996.

Currently, several workplace hazard communication systems cover oxidizers (solids, liquids, gases) as a class of chemicals.

3.1.5 Gases under Pressure

Gases under pressure are gases that are contained in a receptacle at a pressure not less than 280 Pa at 20°C or as a refrigerated liquid. This endpoint covers four types of gases or gaseous mixtures to address the effects of sudden release of pressure or freezing which may lead to serious damage to people, property, or the environment independent of other hazards the gases may pose.

For this group of gases, the following information is required:

- ✓ vapor pressure at 50°C;
- ✓ physical state at 20°C at standard ambient pressure;
- ✓ critical temperature.

Criteria that use the physical state or compressed gases will be a different classification basis for some workplace systems.

Table 3.2 Gases under Pressure

Group	Criteria
Compressed gas	Entirely gaseous at -50°C
Liquefied gas	Partially liquid at temperatures > -50°C
Refrigerated liquefied gas	Partially liquid because of its low temperature
Dissolved gas	Dissolved in a liquid phase solvent

Data can be found in the literature, and calculated or determined by testing. Most pure gases are already classified in the UN Model Regulations. Gases are classified, according to their physical state when packaged, into one of four groups as shown in Table 3.2.

3.1.6 Flammable Liquids

Flammable liquid means a liquid having a flash point of not more than 93°C. Substances and mixtures of this hazard class are assigned to one of four hazard categories on the basis of the flash point and boiling point (See Table 3.3). Flash Point is determined by closed cup methods as provided in the GHS document, Chapter 2.5, paragraph 11.

Table 3.3 Flammable Liquids

Category	Criteria
1	Flash point < 23°C and initial boiling point ≤ 35°C (95°F)
2	Flash point < 23°C and initial boiling point > 35°C (95°F)
3	Flash point ≥ 23°C and ≤ 60°C (140°F)
4	Flash point ≥ 60°C (140°F) and ≤ 93°C (200°F)

3.1.7 Flammable Solids

Flammable solids are solids that are readily combustible, or may cause or contribute to fire through friction. Readily combustible solids are powdered, granular, or pasty substances which are dangerous if they can be easily ignited by brief contact with an ignition source, such as a burning match, and if the flame spreads rapidly.

Substances and mixtures of this hazard class are assigned to one of two hazard categories (Table 3.4) on the basis of the outcome of the UN Test N.1 (UN Manual of Tests and Criteria).

The tests include burning time, burning rate and behavior of fire in a wetted zone of the test sample.

Table 3.4 Flammable Solids

Category	Criteria
1	Metal Powders: burning time ≤ 5 minutes Others: wetted zone does not stop fire & burning time < 45 seconds or burning > 2.2 mm/second
2	Metal Powders: burning time > 5 and ≤ 10 minutes Others: wetted zone stop fire for at least 4 minutes & burning time < 45 seconds or burning rat > 2.2mm/second

3.1.8 Self-Reactive Substances

Self-reactive substances are thermally unstable liquids or solids liable to undergo a strongly exothermic thermal decomposition even without participation of oxygen (air). This definition excludes materials classified under the GHS as explosive, organic peroxides or as oxidizing.

These materials may have similar properties, but such hazards are addressed in their specific endpoints. There are exceptions to the self-reactive classification for material: (i) with heat of decomposition <300 J/g or (ii) with self-accelerating decomposition temperature (SADT) > 75°C for a 50 kg package.

Substances and mixtures of this hazard class are assigned to one of the seven 'Types', A to G, on the basis of the outcome of the UN Test Series A to H (UN Manual of Tests and Criteria). Currently, only the transport sector uses seven categories for self-reactive substances (Table 3.5).

Table 3.5 Self-Reactive Substances

Type	Criteria
A	Can detonate or deflagrate rapidly, as packaged.
B	Possess explosive properties and which, as packaged, neither detonates nor deflagrates, but is liable to undergo a thermal explosion in that package.
C	Possess explosive properties when the substance or mixture as package cannot detonate or deflagrate rapidly or undergo a thermal explosion.
D	Detonates partially, does not deflagrate rapidly and shows no violent effect when heated under confinement; or Does not detonate at all, deflagrates slowly and shows no violent effect when heated under confinement; or Does not detonate or deflagrate at all and shows a medium effect when heated under confinement.
E	Neither detonates nor deflagrates at all and shows low or no effect when heated under confinement.
F	Neither detonates in the cavitated bubble state nor deflagrates at all and shows only a low or no effect when heated under confinement as well as low or no explosive power.
G	Neither detonates in the cavitated state nor deflagrates at all and shows non-effect when heated under confinement nor any explosive power, provided that it is thermally stable (self-accelerating decomposition temperature is 60°C to 75°C for a 50 kg package), and, for liquid mixtures, a diluent having a boiling point not less than 150°C is used for desensitization.

Pyrophorics

3.1.9 Pyrophoric Liquids

A pyrophoric liquid is a liquid which, even in small quantities, is liable to ignite within five minutes after coming into contact with air. Substances and mixtures of this hazard class are assigned to a single hazard category on the basis of the outcome of the UN Test N.3 (UN Manual of Tests and Criteria).

3.1.10 Pyrophoric Solids

A pyrophoric solid is a solid which, even in small quantities, is liable to ignite within five minutes after coming into contact with air. Substances and mixtures of this hazard class are assigned to a single hazard category on the basis of the outcome of the UN Test N.2 (UN Manual of Tests and Criteria).

3.1.11 Self-Heating Substances

A self-heating substance is a solid or liquid, other than a pyrophoric substance, which, by reaction with air and without energy supply, is liable to self-heat. This endpoint differs from a pyrophoric substance in that it will ignite only when in large amounts (kilograms) and after long periods of time (hours or days). Substances and mixtures of this hazard class are assigned to one of two hazard categories on the basis of the outcome of the UN Test N.4 (UN Manual of Tests and Criteria).

3.1.12 Substances which on Contact with Water Emit Flammable Gases

Substances that, in contact with water, emit flammable gases are solids or liquids which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities. Substances and mixtures of this hazard class are assigned to one of three hazard categories on the basis of test results (UN Test N.5 UN Manual of Tests and Criteria) which measure gas evolution and speed of evolution.

Table 3.6 Substances which on Contact with Water Emit Flammable Gases

Category	Criteria
1	≥10 L/kg/1 minute
2	≥20 L/kg/ 1 hour + < 10 L/kg/1 min
3	≥1 L/kg/1 hour + < 20 L/kg/1 hour
Not classified	< 1 L/kg/1 hour

3.1.13 Oxidizing Liquids

An oxidizing liquid is a liquid which, while in itself not necessarily combustible, may, generally by yielding oxygen, cause or contribute to the combustion of other material. Substances and mixtures of this hazard class are assigned to one of three hazard categories on the basis of test results (UN Test O.2 UN Manual of Tests and Criteria) which measure ignition or pressure rise time compared to defined mixtures.

3.1.14 Oxidizing Solids

An oxidizing solid is a solid which, while in itself not necessarily combustible, may, generally by yielding oxygen, cause or contribute to the combustion of other material. Substances and mixtures of this hazard class are assigned to one of three hazard categories on the basis of test results (UN Test O.1 UN Manual of Tests and Criteria) which measure mean burning time and re compared to defined mixtures. Currently, several workplace hazard communication systems cover oxidizers (solids, liquids, gases) as a class of chemicals.

3.1.15 Organic Peroxides

An organic peroxide is an organic liquid or solid which contains the bivalent -0-0- structure and may be considered a derivative of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals. The term also includes organic peroxide formulations (mixtures). Such substances and mixtures may:

- ✓ be liable to explosive decomposition;
- ✓ burn rapidly;
- ✓ be sensitive to impact or friction;
- ✓ react dangerously with other substances.

Substances and mixtures of this hazard class are assigned to one of seven 'Types', A to G, on the basis of the outcome of the UN Test Series A to H (UN Manual of Tests and Criteria). Currently, only the transport sector uses seven categories for organic peroxides.

Table 3.7 Organic Peroxides

Type	Criteria
A	Can detonate or deflagrate rapidly, as packaged.
B	Possess explosive properties and which, as packaged, neither detonates nor deflagrates rapidly, but is liable to undergo a thermal explosion in that package.
C	Possess explosive properties when the substance or mixture as packaged cannot detonate or deflagrate rapidly or undergo a thermal explosion.
D	Detonates partially, does not deflagrate rapidly and shows no violent effect when heated under confinement; or Does not detonate at all, deflagrates slowly and shows no violent effect when heated under confinement; or Does not detonate or deflagrate at all and shows a medium effect when heated under confinement.
E	Neither detonates nor deflagrates at all and shows low or no effect when heated under confinement.
F	Neither detonates in the caviated bubble state nor deflagrates at all and shows only a low or no effect when heated under confinements as well as low or non-explosive power.
G	Neither detonates in the caviated state nor deflagrates at all and shows no effect when heated under confinement nor any explosive power, provided that it is thermally stable (self-accelerating decomposition temperature is 60°C to 75°C for a 50 kg package), and, for liquid mixtures, a diluent having a boiling point not less than 150°C is used for desensitization.

3.1.16 Substances Corrosive to Metal

A substance or a mixture that by chemical action will materially damage, or even destroy, metals is termed 'corrosive to metal'. These substances or mixtures are classified in a single hazard category on the basis of tests (Steel: ISO 9328 (II): 1991 - Steel type P235; Aluminum: ASTM G31-72 (1990) - non-clad types 7075-T6 or AZ5GU-T66). The GHS criteria are a corrosion rate on steel or aluminum surfaces exceeding 6.25 mm per year at a test temperature of 55°C.

The concern in this case is the protection of metal equipment or installations in case of leakage (e.g., plane, ship, tank), not material compatibility between the container/tank and the product. This hazard is not currently covered in all systems.

3.2 What are the GHS Health and Environmental Hazards?
The GHS health and environmental hazard criteria represent a harmonized approach for existing classification systems (see Figure 3.3). The work at the OECD to develop the GHS criteria included:

- ✓ A thorough analysis of existing classification systems, including the scientific basis for a system and its criteria, its rationale and an explanation of the mode of use;
- ✓ A proposal for harmonized criteria for each category. For some categories the harmonized approach was easy to develop because the existing systems had similar approaches. In cases where the approach was different, a compromise consensus proposal was developed.

Health and environmental criteria were established for substances and mixtures.
Figure 3.3
Health Hazard
Acute Toxicity
Skin Corrosion/Irritation
Serious Eye Damage/Eye Irritation
Respiratory or Skin Sensitization
Germ Cell Mutagenicity
Carcinogenicity
Reproductive Toxicology
Target Organ Systemic Toxicity - Single Exposure
Target Organ Systemic Toxicity - Repeated Exposure
Aspiration Toxicity
Environmental Hazard
Hazardous to the Aquatic Environment
Acute aquatic toxicity
Chronic aquatic toxicity
Bioaccumulation potential
Rapid degradability

The GHS Health and Environmental Endpoints
The following paragraphs briefly describe the GHS health and environmental endpoints. The criteria for classifying substances are presented first. Then the GHS approach to classifying mixtures is briefly discussed. It is recommended that the person responsible for GHS implementation consult the GHS Document or "Purple Book" for more complete information.

3.2.1 Acute Toxicity

Five GHS categories have been included in the GHS Acute Toxicity scheme from which the appropriate elements relevant to transport, consumer, worker and environment protection can be selected. Substances are assigned to one of the five toxicity categories on the basis of LD50 (oral, dermal) or LC50 (inhalation). The LC50 values are based on 4-hour tests in animals. The GHS provides guidance on converting 1-hour inhalation test results to a 4-hour equivalent. The five categories are shown in the Table 3.8 Acute Toxicity.

Table 3.8 Acute Toxicity

Acute toxicity	Cat. 1	Cat. 2	Cat. 3	Cat. 4	Category 5
Oral (mg/kg)	≤ 5	> 5 ≤ 50	> 50 ≤ 300	> 300 ≤ 2000	Criteria: Anticipated oral LD50 between 2000 and 5000 mg/kg; Indication of significant effect in humans;* Any mortality at class 4;* Significant clinical signs at class 4;* Indications from other studies.* *If assignment to more hazardous class is not warranted.
Dermal (mg/kg)	≤ 50	> 50 ≤ 200	> 200 ≤ 1000	> 1000 ≤ 2000	
Gases (ppm)	≤ 100	> 100 ≤ 500	> 500 ≤ 2500	> 2500 ≤ 5000	
Vapors (mg/l)	≤ 0.5	> 0.5 ≤ 2.0	> 2.0 ≤ 10	> 10 ≤ 20	
Dust & mists (mg/l)	≤ 0.05	> 0.05 ≤ 0.5	> 0.5 ≤ 1.0	> 1.0 ≤ 5	

Category 1, the most severe toxicity category, has cut-off values currently used primarily by the transport sector for classification for packing groups. Some Competent Authorities may consider combining Acute Categories 1 and 2.

Category 5 is for chemicals which are of relatively low acute toxicity but which, under certain circumstances, may pose a hazard to vulnerable populations. Criteria other than LD50/LC50 data are provided to identify substances in Category 5 unless a more hazardous class is warranted.

3.2.2 Skin Corrosion

Skin corrosion means the production of irreversible damage to the skin following the application of a test substance for up to 4 hours. Substances and mixtures in this hazard class are assigned to a single harmonized corrosion category.

For Competent Authorities, such as transport packing groups, needing more than one designation for corrosivity, up to three subcategories are provided within the corrosive category. See the Skin Corrosion/Irritation Table 3.9.

Several factors should be considered in determining the corrosion potential before testing is initiated:

- ✓ Human experience showing irreversible damage to the skin;
- ✓ Structure/activity or structure property relationship to a substance or mixture already classified as corrosive;
- ✓ pH extremes of less than 2 and more than 11.5 including acid/alkali reserve capacity.

Table 3.9 Skin Corrosion/Irritation

<table>
<tr><td colspan="3">Skin Corrosion
Category 1</td><td>Skin Irritation
Category 2</td><td>Mild Skin Irritation
Category 3</td></tr>
<tr><td colspan="3">Destruction of dermal tissue: visible necrosis in at least one animal</td><td rowspan="2">Reversible adverse effects in dermal tissue

Draize score: ≥ 2.3 < 4.0
or persistent inflammation</td><td rowspan="2">Reversible adverse effects in dermal tissue

Draize score: ≥ 1.5 < 2.3</td></tr>
<tr><td>Subcategory 1A
Exposure < 3 min.
Observation < 1hr,</td><td>Subcategory 1B
Exposure < 1hr.
Observation < 14 days</td><td>Subcategory 1C
Exposure < 4 hrs.
Observation < 14 days</td></tr>
</table>

3.2.3 Skin Irritation

Skin irritation means the production of reversible damage to the skin following the application of a test substance for up to 4 hours. Substances and mixtures in this hazard class are assigned to a single irritant category. For those authorities, such as pesticide regulators, wanting more than one designation for skin irritation, an additional mild irritant category is provided. See the Skin Corrosion/Irritation Table 3.9.

Several factors should be considered in determining the irritation potential before testing is initiated:

- ✓ Human experience or data showing reversible damage to the skin following exposure of up to 4 hours;
- ✓ Structure/activity or structure property relationship to a substance or mixture already classified as an irritant.

3.2.4 Eye Effects

Several factors should be considered in determining the serious eye damage or eye irritation potential before testing is initiated:

- ✓ Accumulated human and animal experience;
- ✓ Structure/activity or structure property relationship to a substance or mixture already classified;
- ✓ pH extremes like < 2 and > 11.5 that may produce serious eye damage.

Table 3.10 Eye Effects

<table>
<tr><td>Category 1
Serious eye damage</td><td colspan="2">Category 2
Eye Irritation</td></tr>
<tr><td rowspan="2">Irreversible damage 21 days after exposure

Draize score:
Corneal opacity ≥ 3
Iritis > 1.5</td><td colspan="2">Reversible adverse effects on cornea, iris, conjunctiva

Draize score:
Corneal opacity ≥ 1
Iritis > 1
Redness ≥ 2
Chemosis ≥ 2</td></tr>
<tr><td>Irritant
Subcategory 2A
Reversible in 21 days</td><td>Mild Irritant
Subcategory 2B
Reversible in 7 days</td></tr>
</table>

Serious eye damage means the production of tissue damage in the eye, or serious physical decay of vision, following application of a test substance to the front surface of the eye, which is not fully reversible within 21 days of application. Substances and mixtures in this hazard class are assigned to a single harmonized category.

Eye irritation means changes in the eye following the application of a test substance to the front surface of the eye, which are fully reversible within 21 days of application. Substances and mixtures in this hazard class are assigned to a single harmonized hazard category. For authorities, such as pesticide regulators, wanting more than one designation for eye irritation, one of two subcategories can be selected, depending on whether the effects are reversible in 21 or 7 days.

3.2.5 Sensitization

Respiratory sensitizer means a substance that induces hypersensitivity of the airways following inhalation of the substance. Substances and mixtures in this hazard class are assigned to one hazard category.

Skin sensitizer means a substance that will induce an allergic response following skin contact. The definition for "skin sensitizer" is equivalent to "contact sensitizer". Substances and mixtures in this hazard class are assigned to one hazard category. Consideration should be given to classifying substances which cause immunological contact urticaria (an allergic disorder) as contact sensitizers.

3.2.6 Germ Cell Mutagenicity

Mutagen means an agent giving rise to an increased occurrence of mutations in populations of cells and/or organisms. Substances and mixtures in this hazard class are assigned to one of two hazard categories. Category 1 has two subcategories. See the Germ Cell Mutagenicity (Table 3.11) below.

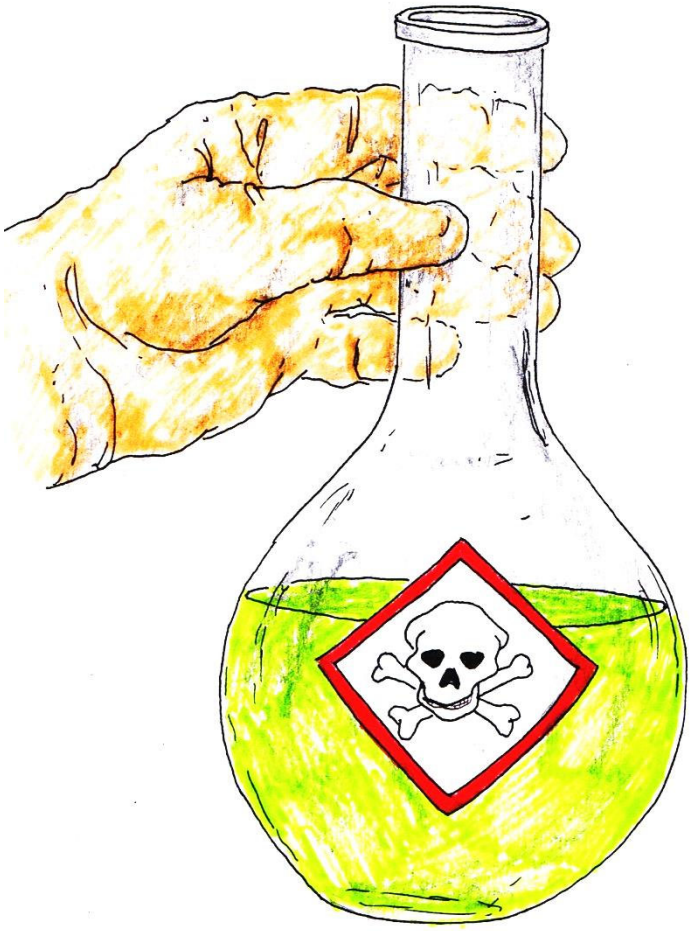


Table 3.11 Germ Cell Mutagenicity

<table>
<tr><td colspan="2">Category 1
Known/Presumed</td><td>Category 2
Suspected/Possible</td></tr>
<tr><td colspan="2">Known to produce heritable mutations in human germ cells</td><td rowspan="2">May include heritable mutations in human germ cells
Positive evidence from tests in mammals and somatic cell tests
In vivo somatic genotoxicity supported by in vitro mutagenicity</td></tr>
<tr><td>Subcategory 1A
Positive evidence from epidemiological studies</td><td>Subcategory 1B
Positive results in:
In vivo heritable germ cell tests in mammals
Human germ cell tests
In vivo somatic mutagenicity tests, combined with some evidence of germ cell mutagenicity</td></tr>
</table>

3.2.7 Carcinogenicity

Carcinogen means a chemical substance or a mixture of chemical substances which induce cancer or increase its incidence. Substances and mixtures in this hazard class are assigned to one of two hazard categories. Category 1 has two subcategories. The Carcinogenicity Guidance Section in the GHS Document includes comments about IARC.

Table 3.12 Carcinogenicity

<table>
<tr><td colspan="2">Category 1
Known or Presumed Carcinogen</td><td>Category 2
Suspected Carcinogen</td></tr>
<tr><td>Subcategory 1A
Known Human Carcinogen Based on human evidence</td><td>Subcategory 1B
Presumed Human Carcinogen
Based on demonstrated animal carcinogenicity</td><td>Limited evidence of human or animal carcinogenicity</td></tr>
</table>

3.2.8 Reproductive Toxicity

Reproductive toxicity includes adverse effects on sexual function and fertility in adult males and females, as well as developmental toxicity in offspring. Substances and mixtures with reproductive and/or developmental effects are assigned to one of two hazard categories, 'known or presumed' and 'suspected'. Category 1 has two subcategories for reproductive and developmental effects. Materials which cause concern for the health of breastfed children have a separate category, Effects on or Via Lactation.

Table 3.13 Reproductive Toxicity

<table>
<tr><td colspan="2">Category 1</td><td>Category 2
Suspected</td><td>Additional
Category</td></tr>
<tr><td colspan="2">Known or presumed to cause effects on human reproduction or on development</td><td rowspan="2">Human or animal evidence possibly with other information</td><td rowspan="2">Effects on or via lactation</td></tr>
<tr><td>Category 1A
Known
Based on human evidence</td><td>Category 1B
Presumed
Based on experimental animals</td></tr>
</table>

3.2.9 Target Organ Systemic Toxicity (TOST): Single Exposure & Repeated Exposure

The GHS distinguishes between single and repeat exposure for Target Organ Effects. Some existing systems distinguish between single and repeat exposure for these effects and some do not.

All significant health effects, not otherwise specifically included in the GHS, that can impair function, both reversible and irreversible, immediate and/or delayed are included in the non-lethal target organ/systemic toxicity class (TOST).

Narcotic effects and respiratory tract irritation are considered to be target organ systemic effects following a single exposure.

Substances and mixtures of the single exposure target organ toxicity hazard class are assigned to one of three hazard categories in Table 3.14.

Table 3.14 TOST: Single Exposure

Category 1	Category 2	Category 3
Significant toxicity in humans - Reliable, good quality human case studies or epidemiological studies Presumed significant toxicity in humans - Animal studies with significant and/or severe toxic effects relevant to humans at generally low exposure (guidance)	Presumed to be harmful to human health - Animal studies with significant toxic effects relevant to humans at generally moderate exposure (guidance) - Human evidence in exceptional cases	Transient target organ effects - Narcotic effects - Respiratory tract irritation

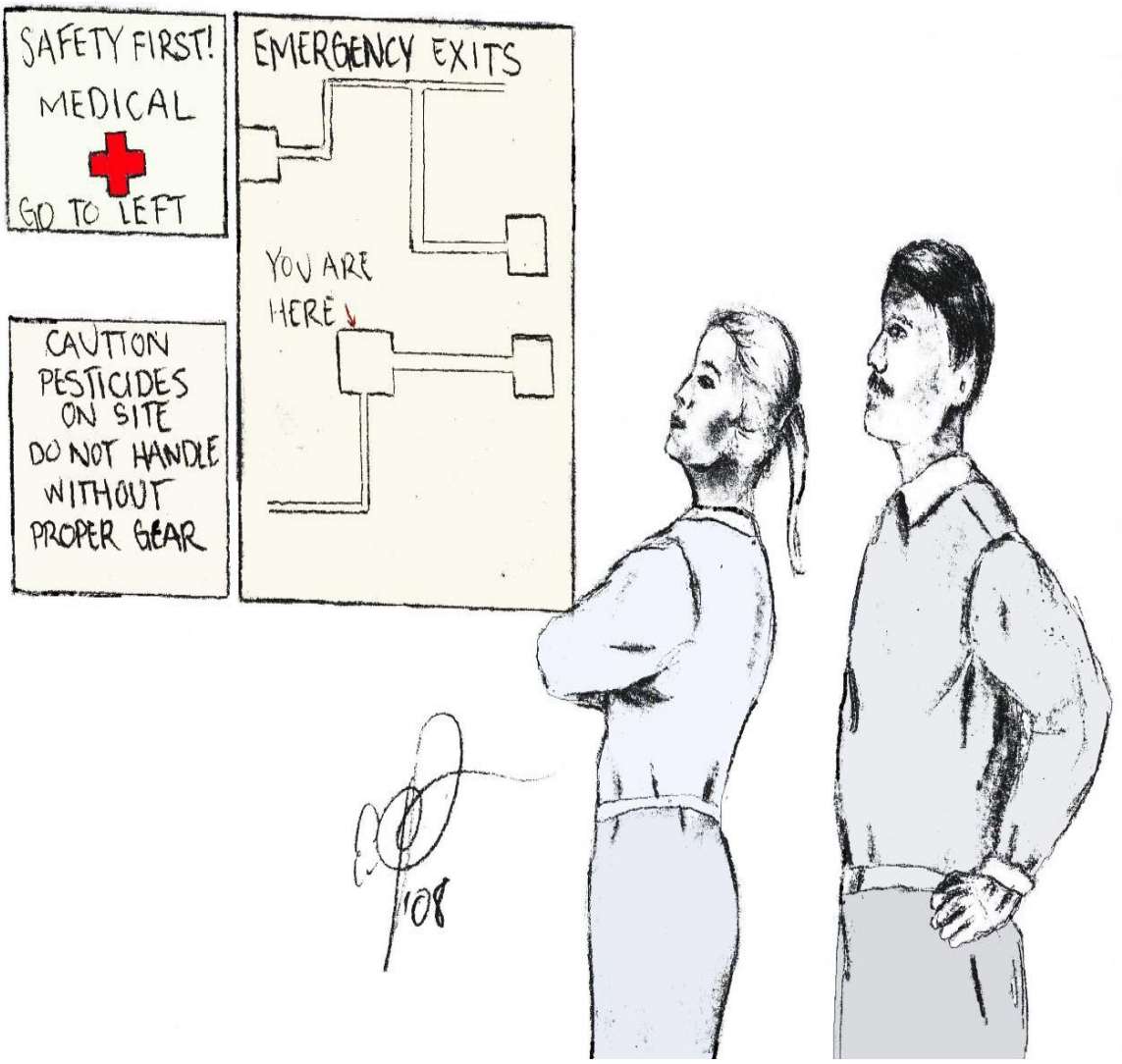
Substances and mixtures of the repeated exposure target organ toxicity hazard class are assigned to one of two hazard categories in Table 3.15.

Table 3.15 TOST: Repeated Exposure

Category 1	Category 2
Significant toxicity in humans - Reliable, good quality human case studies or epidemiological studies Presumed significant toxicity in humans - Animal studies with significant and/or severe toxic effects relevant to humans at generally low exposure (guidance)	Presumed to be harmful to human health - Animal studies with significant toxic effects relevant to humans at generally moderate exposure (guidance) - Human evidence in exceptional cases

In order to help reach a decision about whether a substance should be classified or not, and to what degree it would be classified (Category 1 vs. Category 2), dose / concentration 'guidance values' are provided in the GHS. The guidance values and ranges for single and repeated doses are intended only for guidance purposes.

This means that they are to be used as part of the weight of evidence approach, and to assist with decisions about classification. They are not intended as strict demarcation values. The guidance value for repeated dose effects refer to effects seen in a standard 90-day toxicity study conducted in rats. They can be used as a basis to extrapolate equivalent guidance values for toxicity studies of greater or lesser duration.



3.2.10 Aspiration Hazard

Aspiration toxicity includes severe acute effects such as chemical pneumonia, varying degrees of pulmonary injury or death following aspiration. Aspiration is the entry of a liquid or solid directly through the oral or nasal cavity, or indirectly from vomiting, into the trachea and lower respiratory system. Some hydrocarbons (petroleum distillates) and certain chlorinated hydrocarbons have been shown to pose an aspiration hazard in humans. Primary alcohols, and ketones have been shown to pose an aspiration hazard only in animal studies.

Table 3.16 Aspiration Toxicity

Category 1: Known (regarded) human - human evidence - hydrocarbons with kinematic viscosity ? 20.5 mm2/s at 40° C.	Category 2: Presumed human - Based on animal studies - surface tension, water solubility, boiling point - kinematic viscosity ? 14 mm2/s at 40°C & not Category 1

Substances and mixtures of this hazard class are assigned to one of two hazard categories this hazard class on the basis of viscosity.

3.3 Environmental Hazards

3.3.1 Hazardous to the Aquatic Environment

The harmonized criteria are considered suitable for packaged goods in both supply and use in multi-modal transport schemes. Elements of it may be used for bulk land transport and bulk marine transport under MARPOL (International Convention for the Prevention of Pollution from Ships) insofar as this uses aquatic toxicity.

Two Guidance Documents (Annexes 8 and 9 of the GHS Document) cover issues such as data interpretation and the application of the criteria to special substances. Considering the complexity of this endpoint and the breadth of the application, the Guidance Annexes are important in the application of the harmonized criteria.

3.3.1.1 Acute Aquatic Toxicity

Acute aquatic toxicity means the intrinsic property of a material to cause injury to an aquatic organism in a short-term exposure.

Substances and mixtures of this hazard class are assigned to one of three toxicity categories on the basis of acute toxicity data: LC50 (fish) or EC50 (crustacea) or ErC50 (for algae or other aquatic plants). In some regulatory systems these acute toxicity categories may be subdivided or extended for certain sectors.

It may take two or three people to properly fit a person in to a class a suit. There are many procedures to ensure a proper fit and too ensure the air respirator is working properly, plus you need to time the person in the suit and monitor the medical conditions.

If you can get thirty minutes inside a class A suit, you are doing extremely well. Most people last 15 minutes and then take a break. Heat will take a person down.

3.3.1.2 Chronic Aquatic Toxicity

Chronic aquatic toxicity means the potential or actual properties of a material to cause adverse effects to aquatic organisms during exposures that are determined in relation to the lifecycle of the organism. Substances and mixtures in this hazard class are assigned to one of four toxicity categories on the basis of acute data and environmental fate data: LC50 (fish) or EC50 (crustacea) or ErC50 (for algae or other aquatic plants) and degradation/bioaccumulation.

While experimentally derived test data are preferred, where no experimental data are available, validated Quantitative Structure Activity Relationships (QSARs) for aquatic toxicity and log KOW may be used in the classification process. The log KOW is a surrogate for a measured Bioconcentration Factor (BCF), where such a measured BCF value would always take precedence.

Chronic Category IV is considered a "safety net" classification for use when the available data do not allow classification under the formal criteria, but there are some grounds for concern.

Table 3.17 Acute & Chronic Aquatic Toxicity

Acute Cat. I Acute toxicity ≤ 1.00 mg/l	Acute Cat. II Acute toxicity > 1.00 but ≤ 10.0 mg/l	Acute Cat. III Acute toxicity ≤ 10.0 but < 100 mg/l	
Chronic Cat. I Acute toxicity ≤ 1.00 mg/l and lack of rapid degradability and log Kow ≥ 4 unless BCF < 500	Chronic Cat. II Acute toxicity > 1.00 but ≤ 10.0 mg/l and lack of rapid degradability and log Kow ≥ 4 unless BCF < 500 and unless chronic toxicity > 1 mg/l	Chronic Cat. III Acute toxicity > 10.0 but ≤ 100.0 mg/l and lack of rapid degradability and log Kow ≥ 4 unless BCF < 500 and unless chronic toxicity > 1 mg/l	Chronic Cat. IV Acute toxicity > 100 mg/l and lack of rapid degradability and log Kow ≥ 4 unless BCF < 500 and unless chronic toxicity > 1 mg/l

3.4 What is the GHS approach to classifying mixtures?
For consistency and understanding the provisions for classifying mixtures, the GHS defines certain terms. These working definitions are for the purpose of evaluating or determining the hazards of a product for classification and labeling.

Substance: Chemical elements and their compounds in the natural state or obtained by any production process, including any additive necessary to preserve the stability of the product and any impurities deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition.

Mixture: Mixtures or solutions composed of two or more substances in which they do not react.

Alloy: An alloy is a metallic material, homogeneous on a macroscopic scale, consisting of two or more elements so combined that they cannot be readily separated by mechanical means. Alloys are considered to be mixtures for the purpose of classification under the GHS.

Where impurities, additives or individual constituents of a substance or mixture have been identified and are themselves classified, they should be taken into account during classification if they exceed the cutoff value/concentration limit for a given hazard class.

Figure 3.4
Tier Approach to Classification of Mixtures

Generally, use test data for the mixture, if available,
↓
Compared to substance hazard criteria
Use bridging principles, if applicable
↓
Estimate hazard(s) based on the known component information

As mentioned previously, the GHS physical hazard criteria apply to mixtures. It is assumed that mixtures will be tested for physical hazards. Each health and environmental endpoint chapter in the GHS contains specific criteria for classifying mixtures as well as substances. The GHS Document or "Purple Book" should be consulted for complete information on classifying mixtures.

The process established for classifying a mixture allows the use of (a) available data for the mixture itself and/or (b) similar mixtures and/or (c) data for ingredients of the mixture.

The GHS approach to the classification of mixtures for health and environmental hazards is tiered, and is dependent upon the amount of information available for the mixture itself and for its components. The process for the classification of mixtures is based on the following steps:

(1) Where test data are available for the mixture itself, the classification of the mixture will be based on that data (See exception for carcinogens, mutagens & reproductive toxins in the GHS Document);

(2) Where test data are not available for the mixture itself, then the appropriate bridging principles (as described below) in the specific chapter should be used;

(3) If (i) test data are not available for the mixture itself, and (ii) the bridging principles cannot be applied, then use the calculation or cutoff values described in the specific endpoint to classify the mixture.

3.5 What are Bridging Principles?

Bridging principles are an important concept in the GHS for classifying untested mixtures. When a mixture has not been tested, but there are sufficient data on the components and/or similar tested mixtures, these data can be used in accordance with the following bridging principles:

Dilution: If a mixture is diluted with a diluent that has an equivalent or lower toxicity, then the hazards of the new mixture are assumed to be equivalent to the original.

Batching: If a batch of a complex substance is produced under a controlled process, then the hazards of the new batch are assumed to be equivalent to the previous batches.

Concentration of Highly Toxic Mixtures: If a mixture is severely hazardous, then a concentrated mixture is also assumed to be severely hazardous.

Interpolation within One Toxic Category: Mixtures having component concentrations within a range where the hazards are known are assumed to have those known hazards.

Substantially Similar Mixtures: Slight changes in the concentrations of components are not expected to change the hazards of a mixture and substitutions involving toxicologically similar components are not expected to change the hazards of a mixture

Aerosols: An aerosol form of a mixture is assumed to have the same hazards as the tested, non-aerosolized form of the mixture unless the propellant affects the hazards upon spraying.

All bridging principles do not apply to every health and environmental endpoint. Consult each endpoint to determine which bridging principles apply.

When the bridging principles do not apply or cannot be used, the health and environmental hazards of mixtures are estimated based on component information. In the GHS, the methodology used to estimate these hazards varies by endpoint. The GHS Document or "Purple Book" should be consulted for more complete information on classifying mixtures. Figure 3.5 summarizes the GHS mixtures approach for the various health and environmental endpoints.

3.6 What testing is required?

The GHS itself does not include requirements for testing substances or mixtures. Therefore, there is no requirement under the GHS to generate test data for any hazard class. Some parts of regulatory systems may require data to be generated (e.g., for pesticides), but these requirements are not related specifically to the GHS.

The GHS criteria for determining health and environmental hazards are test method neutral, allowing different approaches as long as they are scientifically sound and validated according to international procedures and criteria already referred to in existing systems.

Test data already generated for the classification of chemicals under existing systems should be accepted when classifying these chemicals under the GHS, thereby avoiding duplicative testing and the unnecessary use of test animals. The GHS physical hazard criteria are linked to specific test methods. It is assumed that mixtures will be tested for physical hazards.

Where employees must travel between workplaces during a workshift, i.e., their work is carried out at more than one geographical location, the material safety data sheets may be kept at the primary workplace facility.

In this situation, the employer shall ensure that employees can immediately obtain the required information in an emergency

Figure 3.5 GHS Mixtures

Hazard Endpoint	Classification Approach	Bridging Principles Comments	
Acute toxicity	Acute Toxicity Estimate (ATE): 2 formulas	All	Conversion values, relevant components usually at ³ 1%
Serious Eye Damage & Eye Irritation	Mostly additivity approach, sometimes cutoffs	All	Relevant components usually at ³ 1%, exceptions for certain chemical classes
Skin corrosion & Skin Irritation	Mostly additivity approach, sometimes cutoffs	All	Relevant components usually at ³ 1%, exceptions for certain chemical classes
Skin Sensitization	Cutoffs with CA options	Dilution, Batching, Substantially similar mixtures, Aerosols	
Respiratory Sensitization	Cutoffs with CA options	Dilution, Batching, Substantially similar mixtures, Aerosols	
Germ Cell Mutagenicity	Cutoffs	Dilution, Batching, Substantially similar mixtures	Mixture test data only case-by case
Carcinogenicity	Cutoffs with CA options	Dilution, Batching, Substantially similar mixtures	Mixture test data only case-by-case
Reproductive Toxicity	Cutoffs with CA options	Dilution, Batching, Substantially similar mixtures	Mixture test data only case-by-case
Target Organ Systemic Toxicity	Cutoffs with CA options	All	
Aspiration Toxicity	Cutoffs	Dilution, Batching, Concentration of highly toxic mixtures, Interpolation within one toxicity category, Substantially similar mixtures	
Hazardous to the Aquatic Environment	Additivity Formula (Acute only); Summation Method (Acute or Chronic); Combination of Additivity Formula & Summation Method	Dilution, Batching, Concentration of highly toxic mixtures, Interpolation within one toxicity category, Substantially similar mixtures	Relevant components usually at ³ 1%, Mixture test data only case-by-case for chronic

These chemical containers where cited in a recent unannounced OSHA inspection. The flammable chemicals were not “grounded and bonded” and notice that the Inspector is asking several related and unrelated questions to this employee.

4.0 Hazard Communication

Section 3, explained that classification is the starting point for the GHS. Once a chemical has been classified, the hazard(s) must be communicated to target audiences. As in existing systems, labels and Safety Data Sheets are the main tools for chemical hazard communication.

They identify the hazardous properties of chemicals that may pose a health, physical or environmental hazard during normal handling or use. The goal of the GHS is to identify the intrinsic hazards found in chemical substances and mixtures, and to convey information about these hazards.

The international mandate for the GHS included the development of a harmonized hazard communication system, including labeling, Safety Data Sheets and easily understandable symbols, based on the classification criteria developed for the GHS.

4.1 What factors influenced development of the GHS communication tools? Early in the process of developing the GHS communication tools, several significant issues were recognized. One of the most important was comprehensibility of the information provided. After all, the aim of the system is to present hazard information in a manner that the intended audience can easily understand and that will thus minimize the possibility of adverse effects resulting from exposure.

The GHS identifies some guiding principles to assist in this process:
Information should be conveyed in more than one way, e.g., text and symbols;

The comprehensibility of the components of the system should take account of existing studies and literature as well as any evidence gained from testing;

The phrases used to indicate degree (severity) of hazard should be consistent across the health, physical and environmental hazards.

Comprehensibility is challenging for a single culture and language. Global harmonization has numerous complexities. Some factors that affected the work include:

- ✓ Different philosophies in existing systems on how and what should be communicated;
- ✓ Language differences around the world;
- ✓ Ability to translate phrases meaningfully;
- ✓ Ability to understand and appropriately respond to symbols/pictograms.

These factors were considered in developing the GHS communication tools. The GHS Purple Book includes a comprehensibility-testing instrument in Annex 6.

This photograph shows a delivery of Sulfuric Acid. The delivery driver is wearing only work gloves. He is clearly in violation of the proper PPE. The Hazard Communication Standard requires employees to understand chemical hazards, labels, and SDSs and to use them on the job.

Before starting jobs involving possible exposure to hazardous substances, employees must read SDSs to know what they're working with and procedures for safe handling.

4.2 Labels

4.2.1 What does a label look like?

Existing systems have labels that look different for the same product. We know that this leads to worker confusion, consumer uncertainty and the need for additional resources to maintain different systems. In the U.S. as well as in other countries, chemical products are regulated by sector/target audience. Different agencies regulate the workplace, consumers, agricultural chemicals and transport. Labels for these sectors/target audiences vary both in the U.S. and globally.

In order to understand the value of the GHS and its benefits to all stakeholders, it is instructive to look at the different labels for one fictional product. In the U.S. the product, ToxiFlam, which has a flash point of 120°F and has an oral LD50 of 275 mg/kg, has different labels for different sectors/target audiences. Label examples as seen in the U.S.A. are shown first, followed by international examples.

4.2.2 USA Examples:

Workplace and Workers

In the U.S., regulatory requirements for workplace labels are 'performance oriented'. This results at a minimum in a straightforward label that has a product identity, hazard statement and supplier identification (Figure 4.1). Some products can also have additional labeling requirements depending on their end use.

Figure 4.1

ToxiFlam
TOXIC
COMBUSTIBLE LIQUID AND
VAPOR

My Company, My Street, MyTown NJ
00000
Tel. 444 999 9999

However, many companies follow the voluntary ANSI Z129.1 Precautionary Labeling Standard for workplace labeling and often use it also for labeling consumer products. The American National Standards Institute (ANSI) standard includes several label elements that are core to the GHS as well as other helpful elements to assist users in safe handling (Figure 4.2).

Figure 4.2

ToxiFlam (Contains XYZ)

WARNING! HARMFUL IF SWALLOWED, FLAMMABLE LIQUID AND VAPOR

Do not taste or swallow. Do not take internally. Wash thoroughly after handling. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation.

FIRST AID: If swallowed, do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person.

In case of Fire, use water fog, dry chemical, CO2, or alcohol foam. Water may be ineffective.

Flash Point = 120°F. Residue vapor may explode or ignite on ignition; do not cut, drill, grind, or weld on or near the container.

See Material Safety Data Sheet for further details regarding safe use of this product.

My Company, My Street, MyTown NJ 00000 Tel. 444 999 9999

Consumer Products and Consumers

Figure 4.3
ToxiFlam
(Contains XYZ)

WARNING! HARMFUL IF SWALLOWED, FLAMMABLE LIQUID AND VAPOR
Do not taste or swallow. Do not take internally. Wash thoroughly after handling. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation.

FIRST AID
If swallowed, do NOT induce vomiting unless directed to do so by medical personnel. Never give anything by mouth to an unconscious person.
Keep out of reach of children

My Company, My Street, MyTown NJ 00000 Tel. 444 999 9999

In several countries consumer products are regulated separately from workplace chemicals. In the U.S. the CPSC regulates consumer products. Consumer products have required label elements, but only the signal words are specified. The ANSI labeling standard is often used in developing consumer labels.

Transport and Emergency Responders

For hazardous products being transported, outer containers have required label elements, product identifier and hazard symbols. Transportation requirements are in addition to workplace or end use label requirements.

Figure 4.4
Flammable liquids, toxic, n.o.s. (contains XYZ)
UN 1992

My Company, My Street NJ 00000

Agricultural Chemicals and Pesticides
In many systems, agricultural chemicals often have special label requirements. In the U.S. the EPA is the agency covering these chemicals. A pesticide product with the same hazards as ToxiFlam would have a label developed using FIFRA requirements. FIFRA has requirements for product identity, chemical identity, signal word, hazard statements, and precautionary measures including first aid.
Figure 4.5
ToxiFlam
Active/ Inerts: Contains XYZ %

KEEP OUT OF THE REACH OF CHILDREN
PRECAUTIONARY STATEMENTS - HAZARDS TO HUMANS AND DOMESTIC ANIMALS:
WARNING: May be fatal if swallowed. Wash thoroughly with soap and water after handling and before eating, drinking or using tobacco .
PHYSICAL AND CHEMICAL HAZARDS: Combustible. Do not use or store near heat or open flame.

FIRST AID:
If swallowed
- Call a poison control center or doctor immediately for treatment advice.
- Have person sip a glass of water if able to swallow.
- Do not induce vomiting unless told to do so by a poison control center or doctor.
- Do not give anything by mouth to an unconscious person.
My Company, My Street, My Town AZ 00000, Tel: 444 999 9999

EPA Est . No. 5840-AZ-1 EPA Reg. No. 3120-280

4.2.3 International Examples

All the previous examples are specific to the U.S. Many companies do business globally. So in addition to the U.S. regulations, these companies would need to comply with the corresponding regulations in the countries to which they export products. Canada and the EU are two existing systems that were considered in the development of the GHS. To illustrate the differences in labeling, it is interesting to examine an EU and Canadian label for ToxiFlam.

European Union Label
Labels in the EU have chemical identity, symbols, and R/S (Risk and Safety) phrases which are hazard statements, precautionary measures and first aid.

Figure 4.6
ToxiFlam (contains XYZ)

KEEP OUT OF THE REACH OF CHILDREN

Harmful If Swallowed. (R22)
Flammable. (R10)
Keep away from food, drink and animal feeding stuffs. (S13)
Wear suitable protective clothing. (S36)
If swallowed, seek medical advice immediately and show this Container label. (S46)
In case of fire, use water, fog, CO2, or alcohol foam. (S43)

My Company, My Street, MyTown XX 00000, Tel: 44 22 999 9999

Canadian Workplace Hazardous Materials Identification System (WHMIS) Label

The WHMIS label requires product identifier, hazard symbol, hazard statement, precautionary measures, first aid, SDS statement and supplier identification. In addition to these common label elements, WHMIS requires a hatched border.

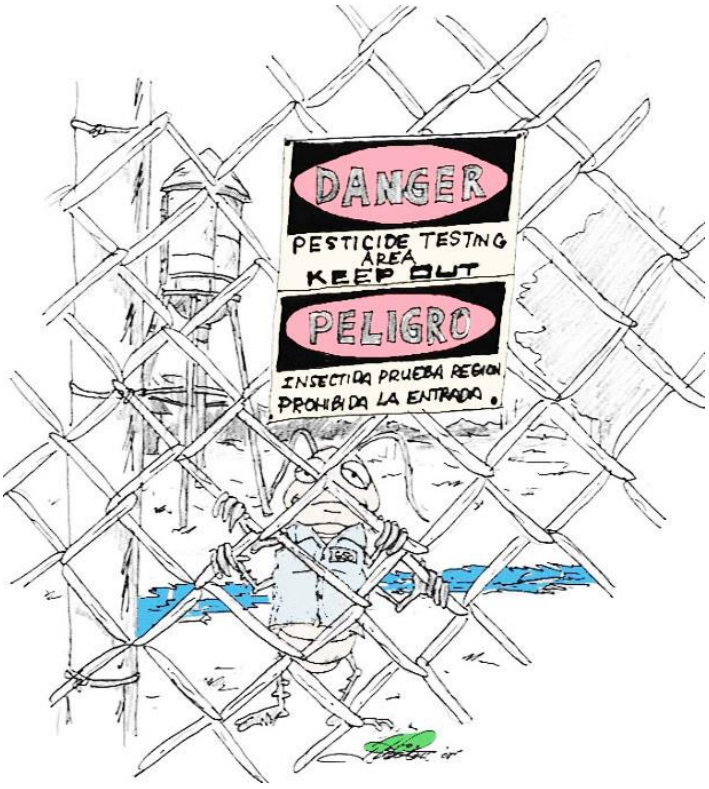
Figure 4.7
ToxiFlam

TOXIC
COMBUSTIBLE LIQUID AND VAPOR
Do not taste or swallow. Do not take internally. Wash thoroughly after handling. Keep away from heat, sparks and flame. Keep container closed. Use only with adequate ventilation.

4.3 What are the GHS label elements?

Some GHS label elements have been standardized (identical with no variation) and are directly related to the endpoints and hazard level.

Other label elements are harmonized with common definitions and/or principles. See Figure 4.8 for an illustration of the GHS label elements.



The standardized label elements included in the GHS are:
Symbols (hazard pictograms): Convey health, physical and environmental hazard information, assigned to a GHS hazard class and category.

Signal Words: "Danger" or "Warning" are used to emphasize hazards and indicate the relative level of severity of the hazard, assigned to a GHS hazard class and category.

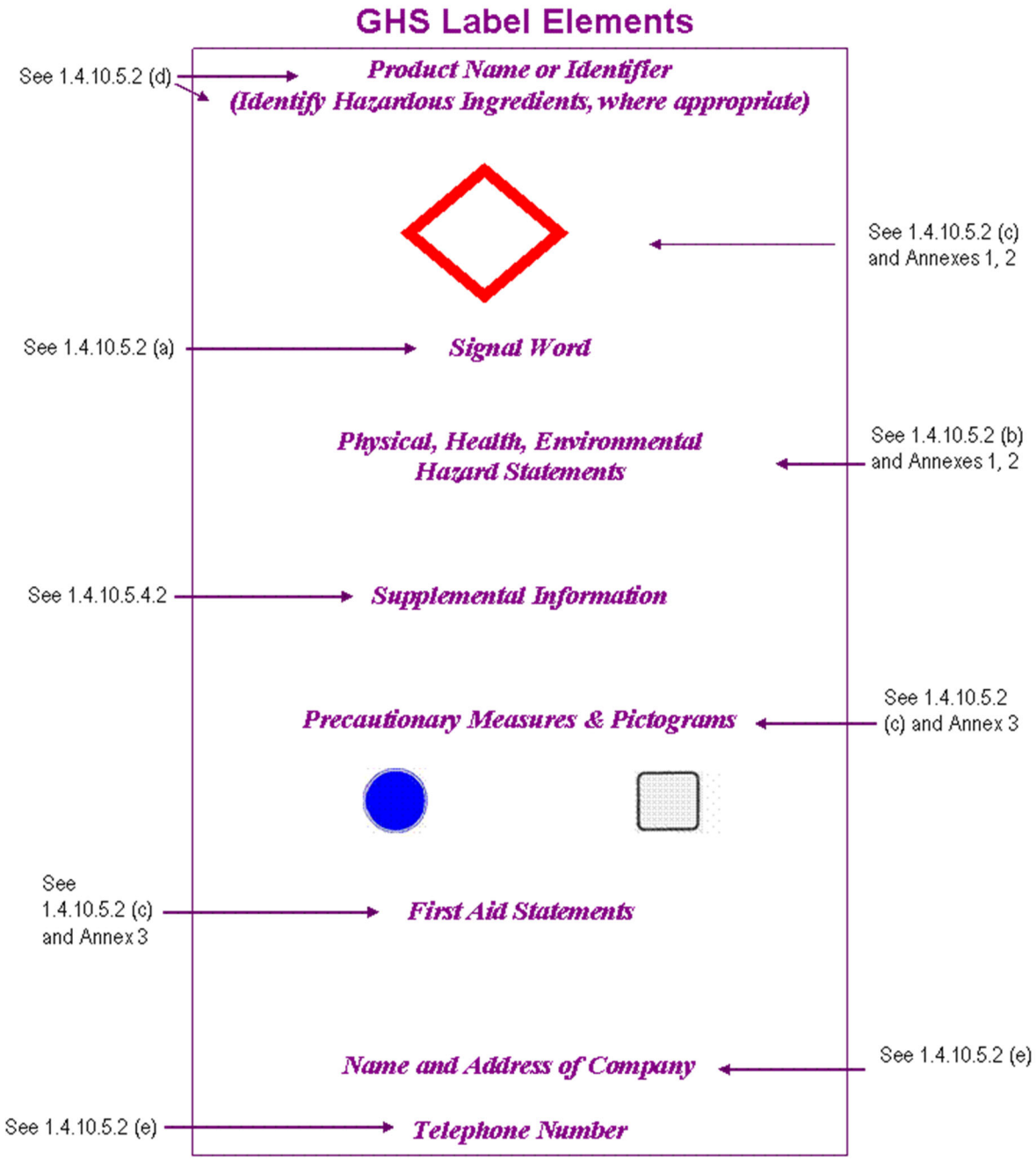
Hazard Statements: Standard phrases assigned to a hazard class and category that describe the nature of the hazard.

The symbols, signal words, and hazard statements have all been standardized and assigned to specific hazard categories and classes, as appropriate. This approach makes it easier for countries to implement the system and should make it easier for companies to comply with regulations based on the GHS.

The prescribed symbols, signal words, and hazard statements can be readily selected from Annex 1 of the GHS Purple Book.

These standardized elements are not subject to variation, and should appear on the GHS label as indicated in the GHS for each hazard category/class in the system. The use of symbols, signal words or hazard statements other than those that have been assigned to each of the GHS hazards would be contrary to harmonization.

Figure 4.8



The Section numbers refer to the sections in the GHS Document or "Purple Book".

4.3.1 Symbols/Pictograms

The GHS symbols have been incorporated into pictograms for use on the GHS label. Pictograms include the harmonized hazard symbols plus other graphic elements, such as borders, background patterns or colors which are intended to convey specific information.

For transport, pictograms (Table 4.10) will have the background, symbol and colors currently used in the UN Recommendations on the Transport of Dangerous Goods, Model Regulations.

For other sectors, pictograms (Table 4.9) will have a black symbol on a white background with a red diamond frame.

A black frame may be used for shipments within one country. Where a transport pictogram appears, the GHS pictogram for the same hazard should not appear.

4.3.2 Signal Words

The signal word indicates the relative degree of severity a hazard. The signal words used in the GHS are

"**Danger**" for the more severe hazards, and
"**Warning**" for the less severe hazards.

Signal words are standardized and assigned to the hazard categories within endpoints. Some lower level hazard categories do not use signal words. Only one signal word corresponding to the class of the most severe hazard should be used on a label.

4.3.3 Hazard Statements

Hazard statements are standardized and assigned phrases that describe the hazard(s) as determined by hazard classification.

An appropriate statement for each GHS hazard should be included on the label for products possessing more than one hazard. The assigned label elements are provided in each hazard chapter of the Purple Book as well as in Annexes 1 & 2. Figure 4-11 illustrates the assignment of standardized GHS label elements for the acute oral toxicity categories.

Figure 4.9

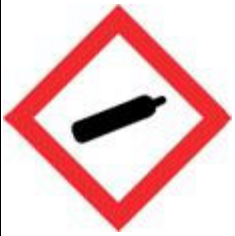
GHS Pictograms and Hazard Classes		
		
Oxidizers	Flammables Self Reactives Pyrophorics Self-Heating Emits Flammable Gas Organic Peroxides	Explosives Self Reactives Organic Peroxides
		
Acute toxicity (severe)	Corrosives	Gases Under Pressure
		
Carcinogen Respiratory Sensitizer Reproductive Toxicity Target Organ Toxicity Mutagenicity Aspiration Toxicity	Environmental Toxicity	Irritant Dermal Sensitizer Acute toxicity (harmful) Narcotic Effects Respiratory Tract Irritation

Figure 4.10

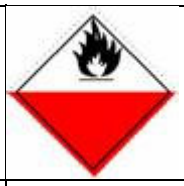
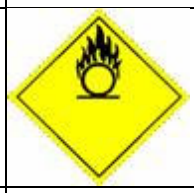
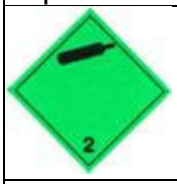
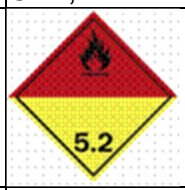
Transport "Pictograms"		
		
Flammable Liquid Flammable Gas Flammable Aerosol	Flammable solid Self-Reactive Substances	Pyrophorics (Spontaneously Combustible) Self-Heating Substances
		
Substances, which in contact with water, emit flammable gases (Dangerous When Wet)	Oxidizing Gases Oxidizing Liquids Oxidizing Solids	Explosive Divisions 1.1, 1.2, 1.3
		
Explosive Division 1.4	Explosive Division 1.5	Explosive Division 1.6
		
Compressed Gases	Acute Toxicity (Poison): Oral, Dermal, Inhalation	Corrosive
		
Marine Pollutant	Organic Peroxides	

Figure 4.11

ACUTE ORAL TOXICITY - Annex 1					
	Category 1	Category 2	Category 3	Category 4	Category 5
LD50	Less 5 mg/kg	> 5 < 50 mg/kg	³ 50 < 300 mg/kg	³ 300 < 2000 mg/kg	³ 2000 < 5000 mg/kg
Pictogram					No symbol
Signal word	Danger	Danger	Danger	Warning	Warning
Hazard statement	Fatal if swallowed	Fatal if swallowed	Toxic if swallowed	Harmful if swallowed	May be harmful if swallowed

Other GHS label elements include:

- ✓ Precautionary Statements and Pictograms: Measures to minimize or prevent adverse effects.
- ✓ Product Identifier (ingredient disclosure): Name or number used for a hazardous product on a label or in the SDS.
- ✓ Supplier identification: The name, address and telephone number should be provided on the label.
- ✓ Supplemental information: non-harmonized information.

4.3.4 Precautionary Statements and Pictograms

Precautionary information supplements the hazard information by briefly providing measures to be taken to minimize or prevent adverse effects from physical, health or environmental hazards. First aid is included in precautionary information.

The GHS label should include appropriate precautionary information. Annex 3 of the GHS Purple Book includes precautionary statements and pictograms that can be used on labels.

Annex 3 includes four types of precautionary statements covering: prevention, response in cases of accidental spillage or exposure, storage, and disposal. The precautionary statements have been linked to each GHS hazard statement and type of hazard.

The goal is to promote consistent use of precautionary statements. Annex 3 is guidance and is expected to be further refined and developed over time.

4.3.5 Product Identifier (Ingredient Disclosure)

A product identifier should be used on a GHS label and it should match the product identifier used on the SDS. Where a substance or mixture is covered by the UN Model Regulations on the Transport of Dangerous Goods, the UN proper shipping name should also be used on the package.

The GHS label for a substance should include the chemical identity of the substance (name as determined by IUPAC, ISO, CAS or technical name). For mixtures/alloys, the label should include the chemical identities of all ingredients that contribute to acute toxicity, skin corrosion or serious eye damage, germ cell mutagenicity, carcinogenicity, reproductive toxicity, skin or respiratory sensitization, or Target Organ Systemic Toxicity (TOST), when these hazards appear on the label. Where a product is supplied exclusively for workplace use, the Competent Authority may give suppliers discretion to include chemical identities on the SDS, in lieu of including them on labels. The Competent Authority rules for confidential business information (CBI) take priority over the rules for product identification.

4.3.6 Supplier Identification

The name, address and telephone number of the manufacturer or supplier of the product should be provided on the label.

4.3.7 Supplemental Information

Supplemental label information is non-harmonized information on the container of a hazardous product that is not required or specified under the GHS. In some cases this information may be required by a Competent Authority or it may be additional information provided at the discretion of the manufacturer/distributor. The GHS provides guidance to ensure that supplemental information does not lead to wide variation in information or undermine the GHS information. Supplemental information may be used to provide further detail that does not contradict or cast doubt on the validity of the standardized hazard information. It also may be used to provide information about hazards not yet incorporated into the GHS. The labeler should have the option of providing supplementary information related to the hazard, such as physical state or route of exposure, with the hazard statement.

4.4 How are multiple hazards handled on labels?

Where a substance or mixture presents more than one GHS hazard, there is a GHS precedence scheme for pictograms and signal words. For substances and mixtures covered by the UN Recommendations on the Transport of Dangerous Goods, Model Regulations, the precedence of symbols for physical hazards should follow the rules of the UN Model Regulations. For health hazards the following principles of precedence apply for symbols:

(a) if the skull and crossbones applies, the exclamation mark should not appear;
(b) if the corrosive symbol applies, the exclamation mark should not appear where it is used for skin or eye irritation;
(c) if the health hazard symbol appears for respiratory sensitization, the exclamation mark should not appear where it is used for skin sensitization or for skin or eye irritation.

If the signal word 'Danger' applies, the signal word 'Warning' should not appear. All assigned hazard statements should appear on the label. The Competent Authority may choose to specify the order in which they appear.

4.5 Is there a specific GHS label format / layout?
The GHS hazard pictograms, signal word and hazard statements should be located together on the label. The actual label format or layout is not specified in the GHS. National authorities may choose to specify where information should appear on the label or allow supplier discretion.

Figure 4.12 shows an example of a GHS label for the fictional product 'ToxiFlam'. The core GHS label elements are expected to replace the need for the array of different labels shown earlier for ToxiFlam. (Figure 4.8 also illustrates the GHS label elements.)

The written program should provide enough details about the employer's plans in this area to assess whether or not a good faith effort is being made to train employees. OSHA does not expect that every worker will be able to recite all of the information about each chemical in the workplace.

In general, the most important aspects of training under the HCS are to ensure that employees are aware that they are exposed to hazardous chemicals, that they know how to read and use labels and material safety data sheets, and that, as a consequence of learning this information, they are following the appropriate protective measures established by the employer. OSHA compliance officers will be talking to employees to determine if they have received training, if they know they are exposed to hazardous chemicals, and if they know where to obtain substance-specific information on labels and SDSs.

Figure 4.12 Example GHS Inner Container Label (e.g., bottle inside a shipping box)

ToxiFlam (Contains: XYZ)

Danger! Toxic If Swallowed, Flammable Liquid and Vapor

Do not eat, drink or use tobacco when using this product. Wash hands thoroughly after handling.
Keep container tightly closed. Keep away from heat/sparks/open flame. - No smoking. Wear protective gloves and eye/face protection. Ground container and receiving equipment. Use explosion-proof electrical equipment. Take precautionary measures against static discharge.
Use only non-sparking tools. Store in cool/well-ventilated place.
IF SWALLOWED: Immediately call a POISON CONTROL CENTER or doctor/physician. Rinse mouth.

In case of fire, use water fog, dry chemical, CO2, or "alcohol" foam.
See Material Safety Data Sheet for further details regarding safe use of this product.

MyCompany, MyStreet, MyTown NJ 00000, Tel: 444 999 9999

There has been discussion about the size of GHS pictograms and that a GHS pictogram might be confused with a transport pictogram or "diamond". Transport pictograms (Table 4.10) are different in appearance than the GHS pictograms (Table 4.9). Annex 7 of the Purple Book explains how the GHS pictograms are expected to be proportional to the size of the label text. So that generally the GHS pictograms would be smaller than the transport pictograms.

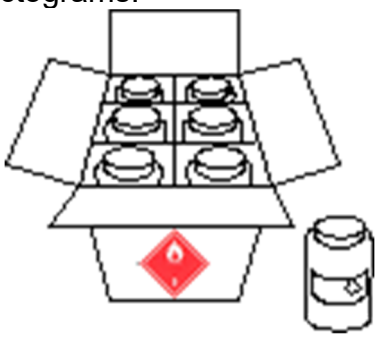


Figure 4.13 Combination Packaging (Outer box with inner bottles)

Several arrangements for GHS labels are also provided in Annex 7 of the Purple Book. Figure 4.13 shows an arrangement for a combination packaging with an outer shipping box and inner bottles. The shipping box has a transportation pictogram. The inner bottles have a GHS label with a GHS pictogram.

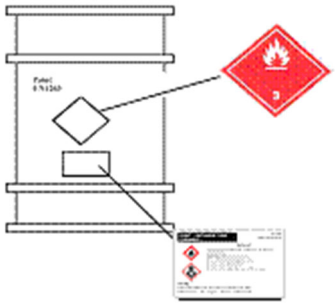


Figure 4.14 Combination Packaging (Outer box with inner bottles)

For a container such as a 55 gallon drum, the transport required markings and pictograms may be combined with the GHS label elements or presented separately. In Figure 4.14 a label arrangement for a single packaging such as a 55 gallon drum is shown. Pictograms and markings required by the transport regulations as well as GHS label and non-duplicative GHS pictogram are shown on the drum.

A label merging the transportation requirements and the GHS requirements into one label for the fictional product "ToxiFlam" is shown in Figure 4.15. This combined type label could also be used on a 55 gallon drum.

Figure 4.15 Example GHS Outer Container Label (55 gallon/200 liter drum)

ToxiFlam

Danger! Toxic If Swallowed
Flammable Liquid and Vapor

Flammable liquids, toxic, n.o.s.
(contains XYZ)
UN 1992

Do not eat, drink or use tobacco when using this product. Wash hands thoroughly after handling. Keep container tightly closed. Keep away from heat/sparks/open flame. - No smoking. Wear protective gloves and eye/face protection. Ground container and receiving equipment. Use explosion-proof electrical equipment. Take precautionary measures against static discharge. Use only non-sparking tools. Store in cool/well-ventilated place

IF SWALLOWED: Immediately call a POISON CONTROL CENTER or doctor/physician. Rinse mouth.

In case of fire, use water fog, dry chemical, CO2, or "alcohol" foam.

See Material Safety Data Sheet for further details regarding safe use of this product.

MyCompany, MyStreet, MyTown NJ 00000, Tel: 444 999 9999

4.6 What about risk?
Competent Authorities may vary the application of the components of the GHS by the type of product (industrial, pesticide, consumer, etc.) or the stage in the lifecycle (workplace, farm, retail store, etc.). Once a chemical is classified, the likelihood of adverse effects may be considered in deciding what informational or other steps should be taken for a given product or use setting. Annex 5 of the GHS Purple Book includes a discussion of an example of how risk-based labeling could be considered for chronic health effects of consumer products in the consumer use setting.

4.7 Are workplace containers covered in the GHS?
Products falling within the scope of the GHS will carry the GHS label at the point where they are supplied to the workplace, and that label should be maintained on the supplied container in the workplace. The GHS label or label elements can also be used for workplace containers (e.g., storage tanks). However, the Competent Authority can allow employers to use alternative means of giving workers the same information in a different written or displayed format when such a format is more appropriate to the workplace and communicates the information as effectively as the GHS label. For example, label information could be displayed in the work area, rather than on the individual containers. Some examples of workplace situations where chemicals may be transferred from supplier containers include: containers for laboratory testing, storage vessels, piping or process reaction systems or temporary containers where the chemical will be used by one worker within a short timeframe.

4.8 What is the GHS Safety Data Sheet (SDS)?
The (Material) Safety Data Sheet (SDS) provides comprehensive information for use in workplace chemical management. Employers and workers use the SDS as sources of information about hazards and to obtain advice on safety precautions. The SDS is product related and, usually, is not able to provide information that is specific for any given workplace where the product may be used.

However, the SDS information enables the employer to develop an active program of worker protection measures, including training, which is specific to the individual workplace and to consider any measures that may be necessary to protect the environment. Information in a SDS also provides a source of information for other target audiences such as those involved with the transport of dangerous goods, emergency responders, poison centers, those involved with the professional use of pesticides and consumers.

The SDS should contain 16 headings (Figure 4.14). The GHS MSDS headings, sequence and content are similar to the ISO, EU and ANSI MSDS/SDS requirements, except that the order of sections 2 and 3 have been reversed. The SDS should provide a clear description of the data used to identify the hazards. Figure 4.14 and the GHS Purple Book provide the minimum information that is required in each section of the SDS. Examples of draft GHS SDSs are provided in Appendix B of this guidance document.

The revised Purple Book contains guidance on developing a GHS SDS (Annex 4). Other resources for SDSs include:

ILO Standard under the Recommendation 177 on Safety in the Use of Chemicals at Work,

International Standard 11014-1 (1994) of the International Standard Organization (ISO) and ISO Safety Data Sheet for Chemical Products 11014-1: 2003 DRAFT,

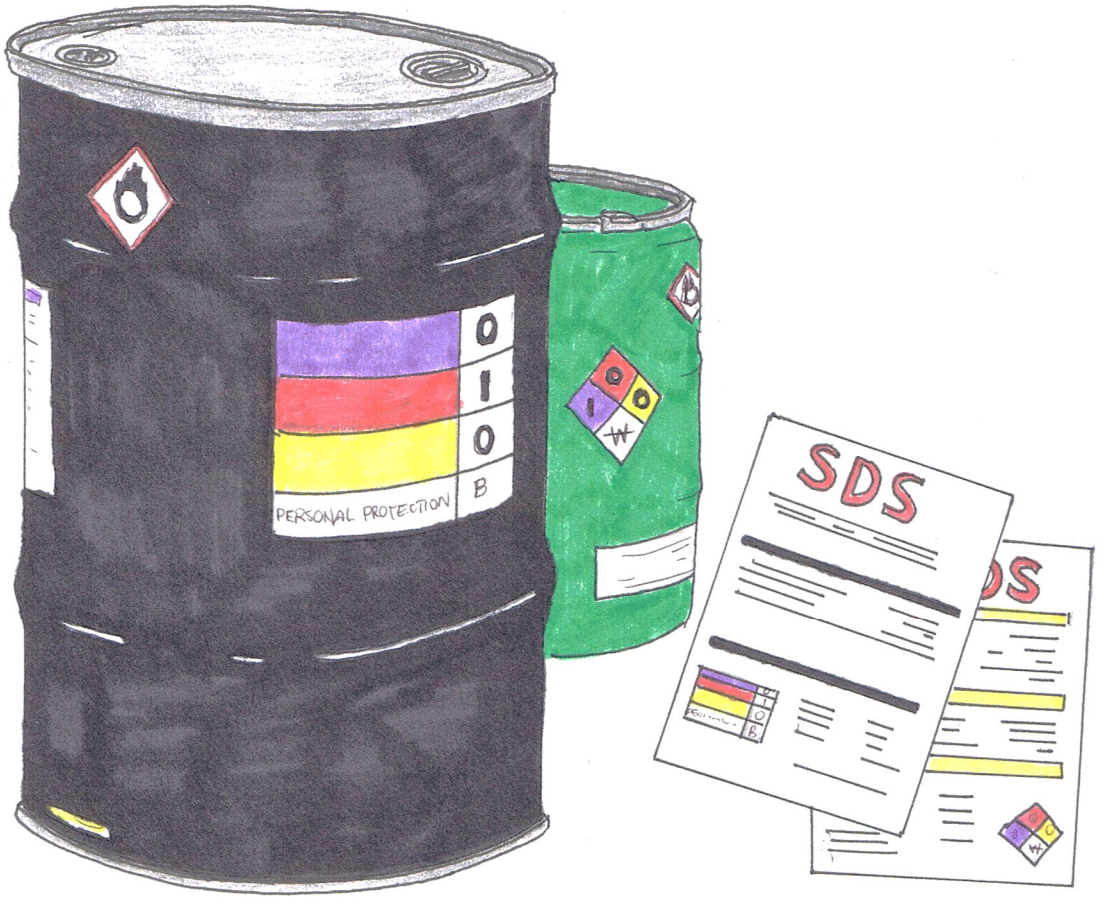


Figure 4.14

Minimum information for an SDS

1.	Identification of the substance or mixture and of the supplier	GHS product identifier. Other means of identification. Recommended use of the chemical and restrictions on use. Supplier's details (including name, address, phone number, etc.). Emergency phone number.
2.	Hazards identification	GHS classification of the substance/mixture and any national or regional information. GHS label elements, including precautionary statements. (Hazard symbols may be provided as a graphical reproduction of the symbols in black and white or the name of the symbol, e.g., flame, skull and crossbones.) Other hazards which do not result in classification (e.g., dust explosion hazard) or are not covered by the GHS.
3.	Composition/information on ingredients	Substance Chemical identity. Common name, synonyms, etc. CAS number, EC number, etc. Impurities and stabilizing additives which are themselves classified and which contribute to the classification of the substance. Mixture The chemical identity and concentration or concentration ranges of all ingredients which are hazardous within the meaning of the GHS and are present above their cutoff levels. NOTE: For information on ingredients, the competent authority rules for CBI take priority over the rules for product identification.

4.	First aid measures	Description of necessary measures, subdivided according to the different routes of exposure, i.e., inhalation, skin and eye contact, and ingestion. Most important symptoms/effects, acute and delayed. Indication of immediate medical attention and special treatment needed, if necessary.
5.	Firefighting measures	Suitable (and unsuitable) extinguishing media. Specific hazards arising from the chemical (e.g., nature of any hazardous combustion products). Special protective equipment and precautions for firefighters.
6.	Accidental release measures	Personal precautions, protective equipment and emergency procedures. Environmental precautions. Methods and materials for containment and cleaning up.
7.	Handling and storage	Precautions for safe handling. Conditions for safe storage, including any incompatibilities.
8.	Exposure controls/personal protection.	Control parameters, e.g., occupational exposure limit values or biological limit values. Appropriate engineering controls. Individual protection measures, such as personal protective equipment.
9.	Physical and chemical properties	Appearance (physical state, color, etc.). Odor. Odor threshold. pH. melting point/freezing point. initial boiling point and boiling range. flash point. evaporation rate. flammability (solid, gas). upper/lower flammability or explosive limits. vapor pressure. vapor density. relative density. solubility(ies). partition coefficient: n-octanol/water. autoignition temperature. decomposition temperature.

10.	Stability and reactivity	Chemical stability. Possibility of hazardous reactions. Conditions to avoid (e.g., static discharge, shock or vibration). Incompatible materials. Hazardous decomposition products.
11.	Toxicological information	Concise but complete and comprehensible description of the various toxicological (health) effects and the available data used to identify those effects, including: information on the likely routes of exposure (inhalation, ingestion, skin and eye contact); Symptoms related to the physical, chemical and toxicological characteristics; Delayed and immediate effects and also chronic effects from short- and long-term exposure; Numerical measures of toxicity (such as acute toxicity estimates).
12.	Ecological information	Ecotoxicity (aquatic and terrestrial, where available). Persistence and degradability. Bioaccumulative potential. Mobility in soil. Other adverse effects.
13.	Disposal considerations	Description of waste residues and information on their safe handling and methods of disposal, including the disposal of any contaminated packaging.
14.	Transport information	UN Number. UN Proper shipping name. Transport Hazard class(es). Packing group, if applicable. Marine pollutant (Yes/No). Special precautions which a user needs to be aware of or needs to comply with in connection with transport or conveyance either within or outside their premises.
15.	Regulatory information	Safety, health and environmental regulations specific for the product in question.
16.	Other information including information on preparation and revision of the SDS	

4.9 What is the difference between the GHS SDS and existing MSDSs/SDSs?
SDSs are in use globally. So it is useful to have an understanding of the similarities and differences in the existing MSDS/SDS content and format and the GHS SDS content and format. A table comparing MSDS/SDS content/format is provided in Appendix A of this guidance document.

4.10 When should SDSs and labels be updated?
All hazard communication systems should specify a means of responding in an appropriate and timely manner to new information and updating labels and SDS information accordingly. Updating should be carried out promptly on receipt of the information that necessitates the revision. The Competent Authority may choose to specify a time limit within which the information should be revised.

Suppliers should respond to "new and significant" information they receive about a chemical hazard by updating the label and safety data sheet for that chemical. New and significant information is any information that changes the GHS classification and leads to a change in the label information or information that may affect the SDS.

4.11 How does the GHS address Confidential Business Information (CBI)?
Confidential business information (CBI) will not be harmonized under the GHS. National authorities should establish appropriate mechanisms for CBI protection. The GHS established CBI principles which include:

- ✓ CBI provisions should not compromise the health and safety of users;
- ✓ CBI claims should be limited to the names of chemicals and their concentrations in mixtures;
- ✓ Mechanisms should be established for disclosure in emergency and non-emergency situations.

4.12 Does the GHS address training?
The GHS states in Chapter 1.4, Section1.4.9, the importance of training all target audiences to recognize and interpret label and/or SDS information, and to take appropriate action in response to chemical hazards. Training requirements should be appropriate for and commensurate with the nature of the work or exposure.

Key target audiences include workers, emergency responders and also those responsible for developing labels and SDSs. To varying degrees, the training needs of additional target audiences have to be addressed. These should include training for persons involved in transport and strategies required for educating consumers in interpreting label information on products that they use.

How will labels change under the revised Hazard Communication Standard?
Under the current Hazard Communication Standard (HCS), the label preparer must provide the identity of the chemical, and the appropriate hazard warnings. This may be done in a variety of ways, and the method to convey the information is left to the preparer. Under the revised HCS, once the hazard classification is completed, the standard specifies what information is to be provided for each hazard class and category.

Labels will require the following elements:
Pictogram: a symbol plus other graphic elements, such as a border, background pattern, or color that is intended to convey specific information about the hazards of a chemical. Each pictogram consists of a different symbol on a white background within a red square frame set on a point (i.e. a red diamond). There are nine pictograms under the GHS. However, only eight pictograms are required under the HCS.

Signal words: a single word used to indicate the relative level of severity of hazard and alert the reader to a potential hazard on the label. The signal words used are "danger" and "warning."

“Danger" is used for the more severe hazards, while "warning" is used for less severe hazards.

Hazard Statement: a statement assigned to a hazard class and category that describes the nature of the hazard(s) of a chemical, including, where appropriate, the degree of hazard.

Precautionary Statement: a phrase that describes recommended measures to be taken to minimize or prevent adverse effects resulting from exposure to a hazardous chemical, or improper storage or handling of a hazardous chemical.

What pictograms are required in the revised Hazard Communication Standard? What hazard does each identify?
There are nine pictograms under the GHS to convey the health, physical and environmental hazards. The final Hazard Communication Standard (HCS) requires eight of these pictograms, the exception being the environmental pictogram, as environmental hazards are not within OSHA's jurisdiction.

Can I use a black border on pictograms for domestic shipment?
Under the revised Hazard Communication Standard (HCS), pictograms must have red borders. OSHA believes that the use of the red frame will increase recognition and comprehensibility. Therefore, the red frame is required regardless of whether the shipment is domestic or international.

Will OSHA allow blank red borders?
The revised Hazard Communication Standard (HCS) requires that all red borders printed on the label have a symbol printed inside it. If OSHA were to allow blank red borders, workers may be confused about what they mean and concerned that some information is missing. OSHA has determined that prohibiting the use of blank red borders on labels is necessary to provide the maximum recognition and impact of warning labels and to ensure that users do not get desensitized to the warnings placed on labels.

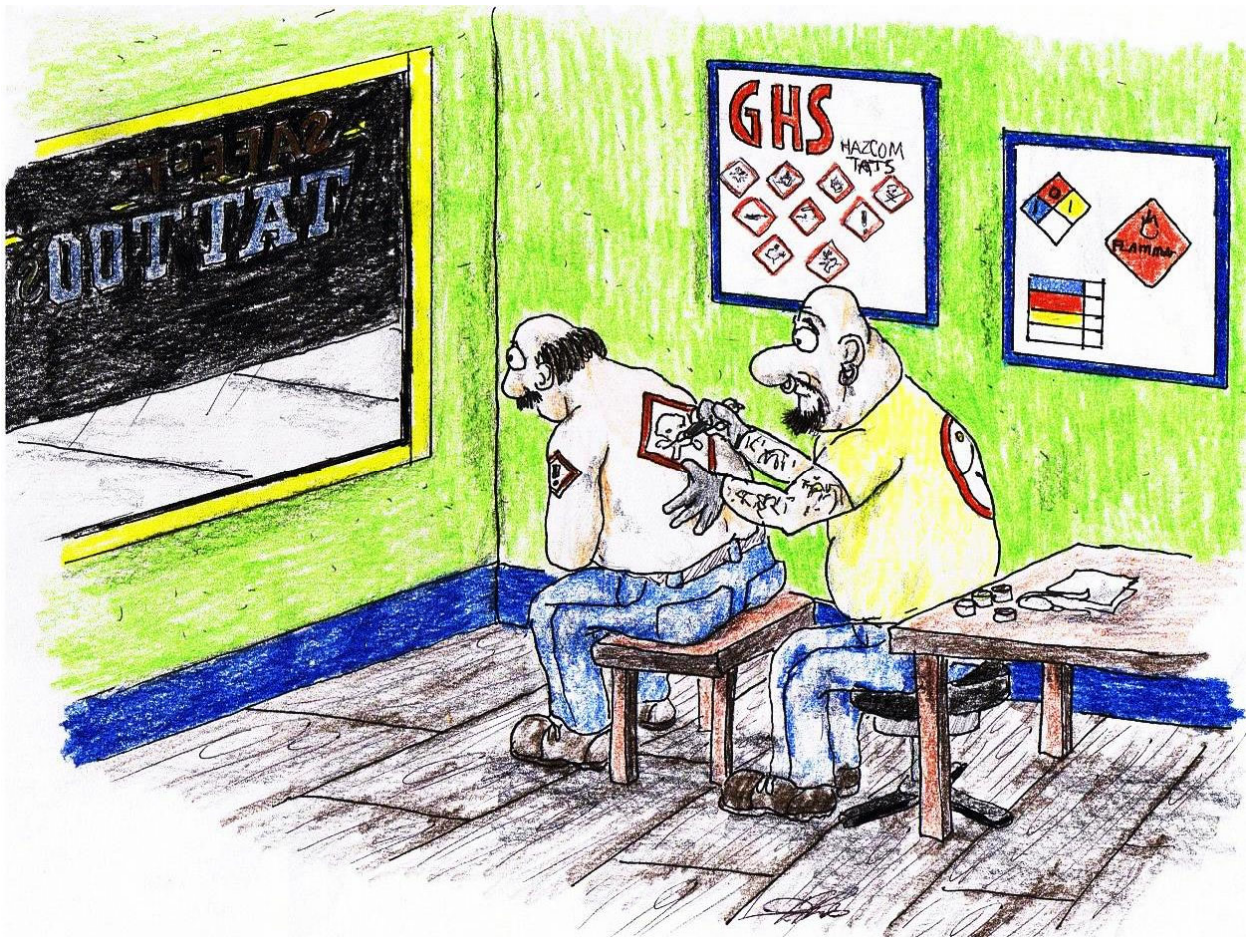
When must label information be updated?
In the revised Hazard Communication Standard (HCS), OSHA is lifting the stay on enforcement regarding the provision to update labels when new information on hazards becomes available. Chemical manufacturers, importers, distributors, or employers who become newly aware of any significant information regarding the hazards of a chemical shall revise the labels for the chemical within six months of becoming aware of the new information, and shall ensure that labels on containers of hazardous chemicals shipped after that time contain the new information. If the chemical is not currently produced or imported, the chemical manufacturer, importer, distributor, or employer shall add the information to the label before the chemical is shipped or introduced into the workplace again.

How will workplace labeling provisions be changing under the revised Hazard Communication Standard?
The current standard provides employers with flexibility regarding the type of system to be used in their workplaces and OSHA has retained that flexibility in the revised Hazard Communication Standard (HCS). Employers may choose to label workplace containers either with the same label that would be on shipped containers for the chemical under the revised rule, or with label alternatives that meet the requirements for the standard. Alternative labeling systems such as the National Fire Protection Association (NFPA) 704 Hazard Rating and the Hazardous Material Information System (HMIS) are permitted for workplace containers. However, the information supplied on these labels must be consistent with the revised HCS, e.g., no conflicting hazard warnings or pictograms.

How is the Safety Data Sheet (SDS) changing under the revised Hazard Communication Standard?
The information required on the safety data sheet (SDS) will remain essentially the same as that in the current standard. The current Hazard Communication Standard (HCS) indicates what information has to be included on an SDS but does not specify a format for presentation or order of information. The revised HCS requires that the information on the SDS is presented using consistent headings in a specified sequence. Paragraph (g) of the final rule indicates the headings of information to be included on the SDS and the order in which they are to be provided. In addition, Appendix D indicates what information is to be included under each heading. The SDS format is the same as the ANSI standard format which is widely used in the U.S. and is already familiar to many employees.

HCS Pictograms and Hazards

Health Hazard	Flame	Exclamation Mark
		
• Carcinogen • Mutagenicity • Reproductive Toxicity • Respiratory Sensitizer • Target Organ Toxicity • Aspiration Toxicity	• Flammables • Pyrophorics • Self-Heating • Emits Flammable Gas • Self-Reactives • Organic Peroxides	• Irritant (skin and eye) • Skin Sensitizer • Acute Toxicity (harmful) • Narcotic Effects • Respiratory Tract Irritant • Hazardous to Ozone Layer (Non Mandatory)
Gas Cylinder	Corrosion	Exploding Bomb
		
• Gases under Pressure	• Skin Corrosion/ burns • Eye Damage • Corrosive to Metals	• Explosives • Self-Reactives • Organic Peroxides
Flame over Circle	Environment (Non Mandatory)	Skull and Crossbones
		
• Oxidizers	• Aquatic Toxicity	• Acute Toxicity (fatal or toxic)


GHS
HAZCOM
TATS
FLAMMA

The format of the 16-section SDS should include the following sections:

Section 1. Identification
Section 2. Hazard(s) identification
Section 3. Composition/information on ingredients
Section 4. First-Aid measures
Section 5. Fire-fighting measures
Section 6. Accidental release measures
Section 7. Handling and storage
Section 8. Exposure controls/personal protection
Section 9. Physical and chemical properties
Section 10. Stability and reactivity
Section 11. Toxicological information
Section 12. Ecological information
Section 13. Disposal considerations
Section 14. Transport information
Section 15. Regulatory information
Section 16. Other information, including date of preparation or last revision
Sections 12-15 may be included in the SDS, but are not required by OSHA.

Will TLVs be required on the Safety Data Sheet (SDS)?
OSHA is retaining the requirement to include the American Conference of Government Industrial Hygienists (ACGIH) Threshold Limit Values (TLVs) on the safety data sheet (SDS) in the revised Standard. OSHA finds that requiring TLVs on the SDS will provide employers and employees with useful information to help them assess the hazards presented by their workplaces. In addition to TLVs, OSHA permissible exposure limits (PELs), and any other exposure limit used or recommended by the chemical manufacturer, importer, or employer preparing the safety data sheet are also required.

May the International Agency for Research on Cancer (IARC) and the National Toxicology Program (NTP) lists be used to make carcinogen classifications?
In the revised Hazard Communication Standard (HCS), OSHA has provided classifiers with the option of relying on the classification listings of IARC and NTP to make classification decisions regarding carcinogenicity, rather than applying the criteria themselves. OSHA believes that this will make classification easier for classifiers, as well as lead to greater consistency. In addition, OSHA has provided in non-mandatory Appendix F of the revised rule, guidance on hazard classification for carcinogenicity. Part A of Appendix F includes background guidance provided by GHS based on the Preamble of the IARC "Monographs on the Evaluation of Carcinogenic Risks to Humans" (2006).

Will the International Agency for Research on Cancer (IARC) and the National Toxicology Program (NTP) classifications be required on the Safety Data Sheet (SDS)?
OSHA has retained the requirement to include IARC and NTP classifications on safety data sheets (SDSs). Therefore, if a chemical is listed as a carcinogen by either IARC or NTP, it must be noted on the SDS. Additionally, if OSHA finds a chemical to be a carcinogen, it must be noted on the SDS as well.

How has OSHA addressed hazards covered under the current Hazard Communication Standard that have not been addressed by the GHS?
In the Notice of Proposed Rulemaking (NPRM), OSHA proposed to include hazards currently covered under the Hazard Communication Standard (HCS) that have yet to be addressed by the GHS (OSHA provided several examples: simple asphyxiants, and combustible dust) in a separate category called "Unclassified Hazards". In response to comments from the regulated community, OSHA has renamed the category to "Hazards Not Otherwise Classified (HNOC)" to minimize confusion. In the final HCS, HNOC hazards will not be required to be disclosed on the label but will be required to be disclosed in section 2 of the Safety Data Sheet (SDS). This reflects how GHS recommends these hazards should be disclosed. Chemical manufacturers and importers are expected to assess these hazards when they are conducting their hazard evaluation of physical and health hazards. A new or separate evaluation is not required. Also in the final standard, in response to comments, OSHA has removed pyrophoric gases, simple asphyxiants, and combustible dust from the HNOC hazard category and has addressed these chemicals individually (see question below for more information on each hazard).

How has OSHA addressed pyrophoric gases, simple asphyxiants, and combustible dust?
In the revised Hazard Communication Standard (HCS), OSHA has added pyrophoric gases, simple asphyxiants and combustible dust to the definition of "hazardous chemical". OSHA has also added definitions to the revised HCS for pyrophoric gases and simple asphyxiants, and provided guidance on how to define combustible dust for the purposes of complying with the HCS.

Pyrophoric gases:
OSHA has retained the definition for pyrophoric gases from the current HCS. Pyrophoric gases must be addressed both on container labels and SDSs. OSHA has provided label elements for pyrophoric gases which include the signal word "danger" and the hazard statement "catches fire spontaneously if exposed to air".

Simple asphyxiants:
OSHA has revised the definition of simple asphyxiants that was proposed in the Notice of Proposed Rulemaking (NPRM) as a result of comments from the regulated community. In the final HCS, simple asphyxiants must be labeled where appropriate, and be addressed on SDSs.
OSHA has provided label elements for simple asphyxiants which include the signal word "warning" and the hazard statement "may displace oxygen and cause rapid suffocation".

Combustible dust:
OSHA has not provided a definition for combustible dust to the final HCS given ongoing activities in the specific rulemaking, as well as in the United Nations Sub-Committee of Experts on the GHS (UN/SCEGHS). However, guidance is being provided through existing documents, including the Combustible Dust National Emphasis Program Directive CPL 03-00-008, which includes an operative definition, as well as provides information about current responsibilities in this area. In addition, there are a number of voluntary industry consensus standards (particularly those of the NFPA) that address combustible dust.

In the final HCS, combustible dust hazards must be addressed on labels and SDSs. Label elements are provided for combustible dust in the final HCS and include the signal word "warning" and the hazard statement "May form combustible dust concentrations in the air".

For chemicals in a solid form that do not present a combustible dust hazard, but may form combustible dusts while being processed in normal downstream uses, paragraph (f)(4) of the HCS allows the chemical manufacturer some flexibility in labeling requirements. The manufacturer or importer to may transmit the label to the customer at the time of the initial shipment, but the label does not need to be included with subsequent shipments unless it changes. This provides the needed information to the downstream users on the potential hazards in the workplace, while acknowledging that the solid metal or other materials do not present the same hazards that are produced when these materials are processed under normal conditions of use.

How many businesses and workers would be affected by the revised Hazard Communication Standard?
OSHA estimates that over 5 million workplaces in the United States would be affected by the revised Hazard Communication Standard (HCS). These are all those workplaces where employees—a total of approximately 43 million of them—could be exposed to hazardous chemicals. Included among these 5 million workplaces are an estimated 90,000 establishments that create hazardous chemicals; these chemical producers employ almost 3 million workers.

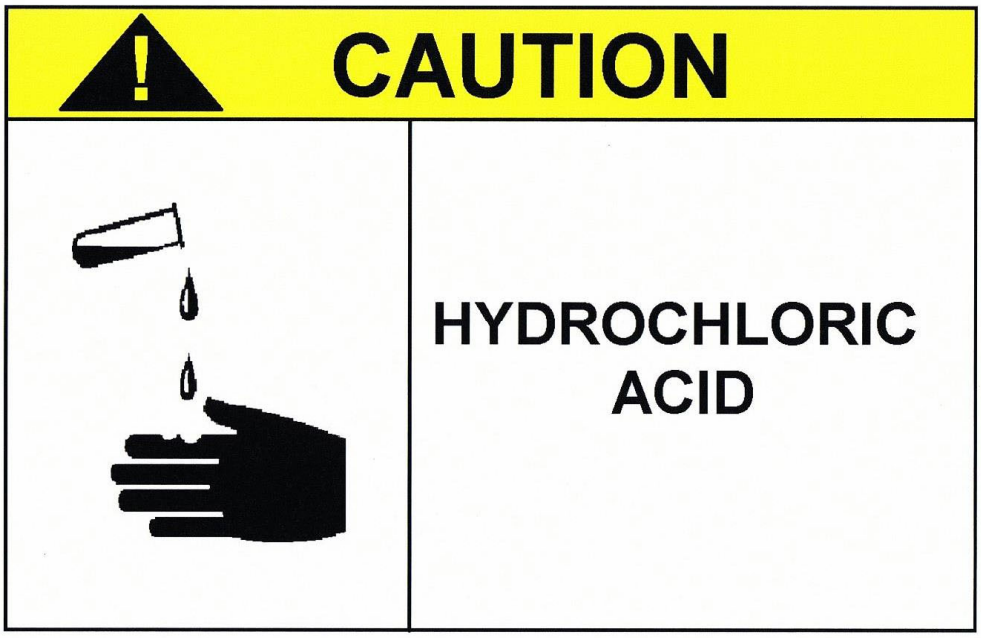
What are the estimated overall costs for industry to comply with the revised Hazard Communication Standard?
The revised Hazard Communications Standard's (HCS) total cost, an estimated $201 million a year on an annualized basis for the entire United States, is the sum of four major cost elements. (1) OSHA estimates that the cost of classifying chemical hazards in accordance with the GHS criteria and revising safety data sheets and labels to meet new format and content requirements would be $22.5 million a year on an annualized basis. (2) OSHA estimates that training for employees to become familiar with new warning symbols and the revised safety data sheet format under GHS would cost $95.4 million a year on an annualized basis. (3) OSHA estimated annualized costs of $59 million a year for management to become familiar with the new GHS system and to engage in other management-related activities as may be necessary for industry's adoption of GHS. (4) OSHA estimated annualized costs of $24.1 million for printing packaging and labels for hazardous chemicals in color.

What are the estimated benefits attributable to the revised Hazard Communication Standard?
OSHA expects that the modifications to the Hazard Communication Standard (HCS) will result in increased safety and health for the affected employees and reduce the numbers of accidents, fatalities, injuries, and illnesses associated with exposures to hazardous chemicals. The GHS revisions to the HCS standard for labeling and safety data sheets would enable employees exposed to workplace chemicals to more quickly obtain and to more easily understand information about the hazards associated with those chemicals.

In addition, the revisions to HCS are expected to improve the use of appropriate exposure controls and work practices that can reduce the safety and health risks associated with exposure to hazardous chemicals.

OSHA estimates that the revised HCS will result in the prevention of 43 fatalities and 585 injuries and illnesses (318 non-lost-workday injuries and illnesses, 203 lost-workday injuries and illnesses, and 64 chronic illnesses) annually. The monetized value of this reduction in occupational risks is an estimated $250 million a year on an annualized basis.

OSHA estimates that the revised HCS will result in savings of $475.2 million from productivity improvements for health and safety managers and logistics personnel, $32.2 million during periodic updating of SDSs and labels, and $285.3 million from simplified hazard communication training.



Hydrochloric acid is a clear, colorless solution of hydrogen chloride (HCl) in water. It is a highly corrosive, strong mineral acid with many industrial uses. Hydrochloric acid is found naturally in gastric acid.

Hydrogen chloride (HCl) is a monoprotic acid, which means it can dissociate (*i.e.,* ionize) only once to give up one H^+ ion (a single proton). In aqueous hydrochloric acid, the H^+ joins a water molecule to form a hydronium ion, H_3O^+:

$$\mathbf{HCl + H_2O \rightarrow H_3O^+ + Cl^-}$$

The other ion formed is Cl^-, the chloride ion. Hydrochloric acid can therefore be used to prepare salts called *chlorides*, such as sodium chloride. Hydrochloric acid is a strong acid, since it is essentially completely dissociated in water.

The NEW OSHA Hazard Communication Standard (HCS)

Note: The following text for 1910.1200 has been updated to align with the UN Globally Harmonized System of Classification and Labeling of Chemicals (GHS), Revision 3, issued in the Federal Register, March 26, 2012. This rule became effective May 25, 2012.

Also, the Hazard Communication page, on OSHA.gov, includes downloadable versions of the revised 1910.1200 Final Rule and appendices, updated to align with the GHS; a comparison of the Hazard Communication Standard, issued in 1994 (HazCom 1994), with the revised Hazard Communication Final Rule issued in 2012 (HazCom 2012); frequently asked questions on the revisions; and new guidance materials on the revisions. The page also contains the full regulatory text and appendices of HazCom 1994.

1910.1200(a)(1)
The purpose of this section is to ensure that the hazards of all chemicals produced or imported are classified, and that information concerning the classified hazards is transmitted to employers and employees. The requirements of this section are intended to be consistent with the provisions of the United Nations Globally Harmonized System of Classification and Labeling of Chemicals (GHS), Revision 3. The transmittal of information is to be accomplished by means of comprehensive hazard communication programs, which are to include container labeling and other forms of warning, safety data sheets and employee training.

1910.1200(a)(2)
This occupational safety and health standard is intended to address comprehensively the issue of classifying the potential hazards of chemicals, and communicating information concerning hazards and appropriate protective measures to employees, and to preempt any legislative or regulatory enactments of a state, or political subdivision of a state, pertaining to this subject. Classifying the potential hazards of chemicals and communicating information concerning hazards and appropriate protective measures to employees, may include, for example, but is not limited to, provisions for: developing and maintaining a written hazard communication program for the workplace, including lists of hazardous chemicals present; labeling of containers of chemicals in the workplace, as well as of containers of chemicals being shipped to other workplaces; preparation and distribution of safety data sheets to employees and downstream employers; and development and implementation of employee training programs regarding hazards of chemicals and protective measures. Under section 18 of the Act, no state or political subdivision of a state may adopt or enforce any requirement relating to the issue addressed by this Federal standard, except pursuant to a Federally-approved state plan.

1910.1200(b)(1)
This section requires chemical manufacturers or importers to classify the hazards of chemicals which they produce or import, and all employers to provide information to their employees about the hazardous chemicals to which they are exposed, by means of a hazard communication program, labels and other forms of warning, safety data sheets, and information and training. In addition, this section requires distributors to transmit the required information to employers. (Employers who do not produce or import chemicals need only focus on those parts of this rule that deal with establishing a workplace program and communicating information to their workers.)

1910.1200(b)(2)
This section applies to any chemical which is known to be present in the workplace in such a manner that employees may be exposed under normal conditions of use or in a foreseeable emergency.

1910.1200(b)(3)
This section applies to laboratories only as follows:

1910.1200(b)(3)(i)
Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

1910.1200(b)(3)(ii)
Employers shall maintain any safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible during each workshift to laboratory employees when they are in their work areas;

1910.1200(b)(3)(iii)
Employers shall ensure that laboratory employees are provided information and training in accordance with paragraph (h) of this section, except for the location and availability of the written hazard communication program under paragraph (h)(2)(iii) of this section; and,

1910.1200(b)(3)(iv)
Laboratory employers that ship hazardous chemicals are considered to be either a chemical manufacturer or a distributor under this rule, and thus must ensure that any containers of hazardous chemicals leaving the laboratory are labeled in accordance with paragraph (f) of this section, and that a safety data sheet is provided to distributors and other employers in accordance with paragraphs (g)(6) and (g)(7) of this section.

1910.1200(b)(4)
In work operations where employees only handle chemicals in sealed containers which are not opened under normal conditions of use (such as are found in marine cargo handling, warehousing, or retail sales), this section applies to these operations only as follows:

1910.1200(b)(4)(i)
Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced;

1910.1200(b)(4)(ii)
Employers shall maintain copies of any safety data sheets that are received with incoming shipments of the sealed containers of hazardous chemicals, shall obtain a safety data sheet as soon as possible for sealed containers of hazardous chemicals received without a safety data sheet if an employee requests the safety data sheet, and shall ensure that the safety data sheets are readily accessible during each work shift to employees when they are in their work area(s); and,

1910.1200(b)(4)(iii)
Employers shall ensure that employees are provided with information and training in accordance with paragraph (h) of this section (except for the location and availability of the written hazard communication program under paragraph (h)(2)(iii) of this section), to

the extent necessary to protect them in the event of a spill or leak of a hazardous chemical from a sealed container.

1910.1200(b)(5)
This section does not require labeling of the following chemicals:

1910.1200(b)(5)(i)
Any pesticide as such term is defined in the Federal Insecticide, Fungicide, and Rodenticide Act (7 U.S.C. 136 et seq.), when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Environmental Protection Agency;

1910.1200(b)(5)(ii)
Any chemical substance or mixture as such terms are defined in the Toxic Substances Control Act (15 U.S.C. 2601 et seq.), when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Environmental Protection Agency;

1910.1200(b)(5)(iii)
Any food, food additive, color additive, drug, cosmetic, or medical or veterinary device or product, including materials intended for use as ingredients in such products (e.g. flavors and fragrances), as such terms are defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.) or the Virus-Serum-Toxin Act of 1913 (21 U.S.C. 151 et seq.), and regulations issued under those Acts, when they are subject to the labeling requirements under those Acts by either the Food and Drug Administration or the Department of Agriculture;

1910.1200(b)(5)(iv)
Any distilled spirits (beverage alcohols), wine, or malt beverage intended for nonindustrial use, as such terms are defined in the Federal Alcohol Administration Act (27 U.S.C. 201 et seq.) and regulations issued under that Act, when subject to the labeling requirements of that Act and labeling regulations issued under that Act by the Bureau of Alcohol, Tobacco, Firearms and Explosives;

1910.1200(b)(5)(v)
Any consumer product or hazardous substance as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq.) and Federal Hazardous Substances Act (15 U.S.C. 1261 et seq.) respectively, when subject to a consumer product safety standard or labeling requirement of those Acts, or regulations issued under those Acts by the Consumer Product Safety Commission; and,

1910.1200(b)(5)(vi)
Agricultural or vegetable seed treated with pesticides and labeled in accordance with the Federal Seed Act (7 U.S.C. 1551 et seq.) and the labeling regulations issued under that Act by the Department of Agriculture.

1910.1200(b)(6)(i)
Any hazardous waste as such term is defined by the Solid Waste Disposal Act, as amended by the Resource Conservation and Recovery Act of 1976, as amended (42 U.S.C. 6901 et seq.), when subject to regulations issued under that Act by the Environmental Protection Agency;

1910.1200(b)(6)(ii)
Any hazardous substance as such term is defined by the Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) (42 U.S.C. 9601 et seq.) when the hazardous substance is the focus of remedial or removal action being conducted under CERCLA in accordance with Environmental Protection Agency regulations.

1910.1200(b)(6)(iii)
Tobacco or tobacco products;

1910.1200(b)(6)(iv)
Wood or wood products, including lumber which will not be processed, where the chemical manufacturer or importer can establish that the only hazard they pose to employees is the potential for flammability or combustibility (wood or wood products which have been treated with a hazardous chemical covered by this standard, and wood which may be subsequently sawed or cut, generating dust, are not exempted);

1910.1200(b)(6)(v)
Articles (as that term is defined in paragraph (c) of this section);

1910.1200(b)(6)(vi)
Food or alcoholic beverages which are sold, used, or prepared in a retail establishment (such as a grocery store, restaurant, or drinking place), and foods intended for personal consumption by employees while in the workplace;

1910.1200(b)(6)(vii)
Any drug, as that term is defined in the Federal Food, Drug, and Cosmetic Act (21 U.S.C. 301 et seq.), when it is in solid, final form for direct administration to the patient (e.g., tablets or pills); drugs which are packaged by the chemical manufacturer for sale to consumers in a retail establishment (e.g., over-the-counter drugs); and drugs intended for personal consumption by employees while in the workplace (e.g., first aid supplies);

1910.1200(b)(6)(viii)
Cosmetics which are packaged for sale to consumers in a retail establishment, and cosmetics intended for personal consumption by employees while in the workplace;

1910.1200(b)(6)(ix)
Any consumer product or hazardous substance, as those terms are defined in the Consumer Product Safety Act (15 U.S.C. 2051 et seq.) and Federal Hazardous Substances Act (15 U.S.C. 1261 et seq.) respectively, where the employer can show that it is used in the workplace for the purpose intended by the chemical manufacturer or importer of the product, and the use results in a duration and frequency of exposure which is not greater than the range of exposures that could reasonably be experienced by consumers when used for the purpose intended;

1910.1200(b)(6)(x)
Nuisance particulates where the chemical manufacturer or importer can establish that they do not pose any physical or health hazard covered under this section;

1910.1200(b)(6)(xi)
Ionizing and nonionizing radiation; and,

1910.1200(b)(6)(xii)
Biological hazards.

1910.1200(c)
Definitions. Article means a manufactured item other than a fluid or particle: (i) which is formed to a specific shape or design during manufacture; (ii) which has end use function(s) dependent in whole or in part upon its shape or design during end use; and (iii) which under normal conditions of use does not release more than very small quantities, e.g., minute or trace amounts of a hazardous chemical (as determined under paragraph (d) of this section), and does not pose a physical hazard or health risk to employees.

Assistant Secretary means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

Chemical means any substance, or mixture of substances.

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

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

Classification means to identify the relevant data regarding the hazards of a chemical; review those data to ascertain the hazards associated with the chemical; and decide whether the chemical will be classified as hazardous according to the definition of hazardous chemical in this section. In addition, classification for health and physical hazards includes the determination of the degree of hazard, where appropriate, by comparing the data with the criteria for health and physical hazards.

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

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

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

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

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

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

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

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

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

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

Hazard category means the division of criteria within each hazard class, e.g., oral acute toxicity and flammable liquids include four hazard categories. These categories compare hazard severity within a hazard class and should not be taken as a comparison of hazard categories more generally.

Hazard class means the nature of the physical or health hazards, e.g., flammable solid, carcinogen, oral acute toxicity.

Hazard not otherwise classified (HNOC) means an adverse physical or health effect identified through evaluation of scientific evidence during the classification process that does not meet the specified criteria for the physical and health hazard classes addressed in this section. This does not extend coverage to adverse physical and health effects for which there is a hazard class addressed in this section, but the effect either falls below the cut-off value/concentration limit of the hazard class or is under a GHS hazard category that has not been adopted by OSHA (e.g., acute toxicity Category 5).

Hazard statement means a statement assigned to a hazard class and category that describes the nature of the hazard(s) of a chemical, including, where appropriate, the degree of hazard.

Hazardous chemical means any chemical which is classified as a physical hazard or a health hazard, a simple asphyxiant, combustible dust, pyrophoric gas, or hazard not otherwise classified.

Health hazard means a chemical which is classified as posing one of the following hazardous effects: acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation; respiratory or skin sensitization; germ cell mutagenicity; carcinogenicity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); or aspiration hazard. The criteria for determining whether a chemical is classified as a health hazard are detailed in Appendix A to §1910.1200—Health Hazard Criteria.

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

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

Label means an appropriate group of written, printed or graphic information elements concerning a hazardous chemical that is affixed to, printed on, or attached to the immediate container of a hazardous chemical, or to the outside packaging.

Label elements means the specified pictogram, hazard statement, signal word and precautionary statement for each hazard class and category.

Mixture means a combination or a solution composed of two or more substances in which they do not react.

Physical hazard means a chemical that is classified as posing one of the following hazardous effects: explosive; flammable (gases, aerosols, liquids, or solids); oxidizer (liquid, solid or gas); self-reactive; pyrophoric (liquid or solid); self-heating; organic peroxide; corrosive to metal; gas under pressure; or in contact with water emits flammable gas. See Appendix B to §1910.1200—Physical Hazard Criteria.

Pictogram means a composition that may include a symbol plus other graphic elements, such as a border, background pattern, or color, that is intended to convey specific information about the hazards of a chemical. Eight pictograms are designated under this standard for application to a hazard category.

Precautionary statement means a phrase that describes recommended measures that should be taken to minimize or prevent adverse effects resulting from exposure to a hazardous chemical, or improper storage or handling.

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

Product identifier means the name or number used for a hazardous chemical on a label or in the SDS. It provides a unique means by which the user can identify the chemical. The product identifier used shall permit cross-references to be made among the list of hazardous chemicals required in the written hazard communication program, the label and the SDS.

Pyrophoric gas means a chemical in a gaseous state that will ignite spontaneously in air at a temperature of 130 degrees F (54.4 degrees C) or below.

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

Safety data sheet (SDS) means written or printed material concerning a hazardous chemical that is prepared in accordance with paragraph (g) of this section.

Signal word means a word used to indicate the relative level of severity of hazard and alert the reader to a potential hazard on the label. The signal words used in this section are "danger" and "warning." "Danger" is used for the more severe hazards, while "warning" is used for the less severe.

Simple asphyxiant means a substance or mixture that displaces oxygen in the ambient atmosphere, and can thus cause oxygen deprivation in those who are exposed, leading to unconsciousness and death.

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

Substance means chemical elements and their compounds in the natural state or obtained by any production process, including any additive necessary to preserve the stability of the product and any impurities deriving from the process used, but excluding any solvent which may be separated without affecting the stability of the substance or changing its composition.

Trade secret means any confidential formula, pattern, process, device, information or compilation of information that is used in an employer's business, and that gives the employer an opportunity to obtain an advantage over competitors who do not know or use it. Appendix E to §1910.1200—Definition of Trade Secret, sets out the criteria to be used in evaluating trade secrets.

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

Work area means a room or defined space in a workplace where hazardous chemicals are produced or used, and where employees are present.

Workplace means an establishment, job site, or project, at one geographical location containing one or more work areas.

Hazard Classification

1910.1200(d)(1)
Chemical manufacturers and importers shall evaluate chemicals produced in their workplaces or imported by them to classify the chemicals in accordance with this section. For each chemical, the chemical manufacturer or importer shall determine the hazard classes, and, where appropriate, the category of each class that apply to the chemical being classified. Employers are not required to classify chemicals unless they choose not to rely on the classification performed by the chemical manufacturer or importer for the chemical to satisfy this requirement.

1910.1200(d)(2)
Chemical manufacturers, importers or employers classifying chemicals shall identify and consider the full range of available scientific literature and other evidence concerning the potential hazards. There is no requirement to test the chemical to determine how to classify its hazards. Appendix A to § 1910.1200 shall be consulted for classification of health hazards, and Appendix B to § 1910.1200 shall be consulted for the classification of physical hazards.

1910.1200(d)(3)
Mixtures.
1910.1200(d)(3)(i)
Chemical manufacturers, importers, or employers evaluating chemicals shall follow the procedures described in Appendices A and B to Sec. 1910.1200 to classify the hazards of the chemicals, including determinations regarding when mixtures of the classified chemicals are covered by this section.

1910.1200(d)(3)(ii)
When classifying mixtures they produce or import, chemical manufacturers and importers of mixtures may rely on the information provided on the current safety data sheets of the individual ingredients, except where the chemical manufacturer or importer knows, or in the exercise of reasonable diligence should know, that the safety data sheet misstates or omits information required by this section.

1910.1200(d)(4)
Chemical manufacturers, importers and employers evaluating chemicals shall treat the following sources as establishing that a chemical is a carcinogen or potential carcinogen for hazard communication purposes:

1910.1200(d)(4)(i)
National Toxicology Program (NTP), Annual Report on Carcinogens (latest edition);

1910.1200(d)(4)(ii)
International Agency for Research on Cancer (IARC) Monographs (latest editions); or

1910.1200(d)(4)(iii)
29 CFR part 1910, subpart Z, Toxic and Hazardous Substances, Occupational Safety and Health Administration.

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

1910.1200(d)(5)
The chemical manufacturer, importer or employer shall determine the hazards of mixtures of chemicals as follows:

1910.1200(d)(5)(i)
If a mixture has been tested as a whole to determine its hazards, the results of such testing shall be used to determine whether the mixture is hazardous;

1910.1200(d)(5)(ii)
If a mixture has not been tested as a whole to determine whether the mixture is a health hazard, the mixture shall be assumed to present the same health hazards as do the components which comprise one percent (by weight or volume) or greater of the mixture, except that the mixture shall be assumed to present a carcinogenic hazard if it contains a component in concentrations of 0.1 percent or greater which is considered to be a carcinogen under paragraph (d)(4) of this section;

1910.1200(d)(5)(iii)
If a mixture has not been tested as a whole to determine whether the mixture is a physical hazard, the chemical manufacturer, importer, or employer may use whatever scientifically valid data is available to evaluate the physical hazard potential of the mixture; and,

1910.1200(d)(5)(iv)
If the chemical manufacturer, importer, or employer has evidence to indicate that a component present in the mixture in concentrations of less than one percent (or in the case of carcinogens, less than 0.1 percent) could be released in concentrations which would exceed an established OSHA permissible exposure limit or ACGIH Threshold Limit Value, or could present a health risk to employees in those concentrations, the mixture shall be assumed to present the same hazard.

1910.1200(d)(6)
Chemical manufacturers, importers, or employers evaluating chemicals shall describe in writing the procedures they use to determine the hazards of the chemical they evaluate. The written procedures are to be made available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director. The written description may be incorporated into the written hazard communication program required under paragraph (e) of this section.

Written Hazard Communication Program

1910.1200(e)(1)
Employers shall develop, implement, and maintain at each workplace, a written hazard communication program which at least describes how the criteria specified in paragraphs (f), (g), and (h) of this section for labels and other forms of warning, safety data sheets, and employee information and training will be met, and which also includes the following:

1910.1200(e)(1)(i)
A list of the hazardous chemicals known to be present using a product identifier that is referenced on the appropriate safety data sheet (the list may be compiled for the workplace as a whole or for individual work areas); and,

1910.1200(e)(1)(ii)
The methods the employer will use to inform employees of the hazards of non-routine tasks (for example, the cleaning of reactor vessels), and the hazards associated with chemicals contained in unlabeled pipes in their work areas.

1910.1200(e)(2)
Multi-employer workplaces. Employers who produce, use, or store hazardous chemicals at a workplace in such a way that the employees of other employer(s) may be exposed (for example, employees of a construction contractor working on-site) shall additionally ensure that the hazard communication programs developed and implemented under this paragraph (e) include the following:

1910.1200(e)(2)(i)
The methods the employer will use to provide the other employer(s) on-site access to safety data sheets for each hazardous chemical the other employer(s)' employees may be exposed to while working;

1910.1200(e)(2)(ii)
The methods the employer will use to inform the other employer(s) of any precautionary measures that need to be taken to protect employees during the workplace's normal operating conditions and in foreseeable emergencies; and,

1910.1200(e)(2)(iii)
The methods the employer will use to inform the other employer(s) of the labeling system used in the workplace.

1910.1200(e)(3)
The employer may rely on an existing hazard communication program to comply with these requirements, provided that it meets the criteria established in this paragraph (e).

1910.1200(e)(4)
The employer shall make the written hazard communication program available, upon request, to employees, their designated representatives, the Assistant Secretary and the Director, in accordance with the requirements of 29 CFR 1910.1020 (e).

1910.1200(e)(5)
Where employees must travel between workplaces during a workshift, i.e., their work is carried out at more than one geographical location, the written hazard communication program may be kept at the primary workplace facility.

1910.1200(f)
Labels and other forms of warning—
1910.1200(f)(1)
Labels on shipped containers. The chemical manufacturer, importer, or distributor shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged, or marked. Hazards not otherwise classified do not have to be addressed on the container. Where the chemical manufacturer or importer is required to label, tag or mark the following information shall be provided:

1910.1200(f)(1)(i)
Product identifier;
1910.1200(f)(1)(ii)
Signal word;
1910.1200(f)(1)(iii)
Hazard statement(s);
1910.1200(f)(1)(iv)
Pictogram(s);
1910.1200(f)(1)(v)
Precautionary statement(s); and,
1910.1200(f)(1)(vi)
Name, address, and telephone number of the chemical manufacturer, importer, or other responsible party.

1910.1200(f)(2)
The chemical manufacturer, importer, or distributor shall ensure that the information provided under paragraphs (f)(1)(i) through (v) of this section is in accordance with Appendix C to § 1910.1200, for each hazard class and associated hazard category for the hazardous chemical, prominently displayed, and in English (other languages may also be included if appropriate).

1910.1200(f)(3)
The chemical manufacturer, importer, or distributor shall ensure that the information provided under paragraphs (f)(1)(ii) through (iv) of this section is located together on the label, tag, or mark.

1910.1200(f)(4)
Solid materials.
1910.1200(f)(4)(i)
For solid metal (such as a steel beam or a metal casting), solid wood, or plastic items that are not exempted as articles due to their downstream use, or shipments of whole grain, the required label may be transmitted to the customer at the time of the initial shipment, and need not be included with subsequent shipments to the same employer unless the information on the label changes;

1910.1200(f)(4)(ii)
The label may be transmitted with the initial shipment itself, or with the safety data sheet that is to be provided prior to or at the time of the first shipment; and,

1910.1200(f)(4)(iii)
This exception to requiring labels on every container of hazardous chemicals is only for the solid material itself, and does not apply to hazardous chemicals used in conjunction with, or known to be present with, the material and to which employees handling the items in transit may be exposed (for example, cutting fluids or pesticides in grains).

1910.1200(f)(5)
Chemical manufacturers, importers, or distributors shall ensure that each container of hazardous chemicals leaving the workplace is labeled, tagged, or marked in accordance with this section in a manner which does not conflict with the requirements of the Hazardous Materials Transportation Act (49 U.S.C. 1801 et seq.) and regulations issued under that Act by the Department of Transportation.

1910.1200(f)(6)
Workplace labeling. Except as provided in paragraphs (f)(7) and (f)(8) of this section, the employer shall ensure that each container of hazardous chemicals in the workplace is labeled, tagged or marked with either:

1910.1200(f)(6)(i)
The information specified under paragraphs (f)(1)(i) through (v) of this section for labels on shipped containers; or,

1910.1200(f)(6)(ii)
Product identifier and words, pictures, symbols, or combination thereof, which provide at least general information regarding the hazards of the chemicals, and which, in conjunction with the other information immediately available to employees under the hazard communication program, will provide employees with the specific information regarding the physical and health hazards of the hazardous chemical.

1910.1200(f)(7)
The employer may use signs, placards, process sheets, batch tickets, operating procedures, or other such written materials in lieu of affixing labels to individual stationary process containers, as long as the alternative method identifies the containers to which it is applicable and conveys the information required by paragraph (f)(6) of this section to be on a label. The employer shall ensure the written materials are readily accessible to the employees in their work area throughout each work shift.

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

1910.1200(f)(9)
The employer shall not remove or deface existing labels on incoming containers of hazardous chemicals, unless the container is immediately marked with the required information.

1910.1200(f)(10)
The employer shall ensure that workplace labels or other forms of warning are legible, in English, and prominently displayed on the container, or readily available in the work area throughout each work shift. Employers having employees who speak other languages may add the information in their language to the material presented, as long as the information is presented in English as well.

1910.1200(f)(11)
Chemical manufacturers, importers, distributors, or employers who become newly aware of any significant information regarding the hazards of a chemical shall revise the labels for the chemical within six months of becoming aware of the new information, and shall ensure that labels on containers of hazardous chemicals shipped after that time contain the new information. If the chemical is not currently produced or imported, the chemical manufacturer, importer, distributor, or employer shall add the information to the label before the chemical is shipped or introduced into the workplace again.

Safety Data Sheets

1910.1200(g)(1)
Chemical manufacturers and importers shall obtain or develop a safety data sheet for each hazardous chemical they produce or import. Employers shall have a safety data sheet in the workplace for each hazardous chemical which they use.

1910.1200(g)(2)
The chemical manufacturer or importer preparing the safety data sheet shall ensure that it is in English (although the employer may maintain copies in other languages as well), and includes at least the following section numbers and headings, and associated information under each heading, in the order listed (See Appendix D to § 1910.1200—Safety Data Sheets, for the specific content of each section of the safety data sheet):

1910.1200(g)(2)(i)
Section 1, Identification;
1910.1200(g)(2)(ii)
Section 2, Hazard(s) identification;
1910.1200(g)(2)(iii)
Section 3, Composition/information on ingredients;
1910.1200(g)(2)(iv)
Section 4, First-aid measures;
1910.1200(g)(2)(v)
Section 5, Fire-fighting measures;

1910.1200(g)(2)(vi)
Section 6, Accidental release measures;
1910.1200(g)(2)(vii)
Section 7, Handling and storage;
1910.1200(g)(2)(viii)
Section 8, Exposure controls/personal protection;
1910.1200(g)(2)(ix)
Section 9, Physical and chemical properties;
1910.1200(g)(2)(x)
Section 10, Stability and reactivity;

1910.1200(g)(2)(xi)
Section 11, Toxicological information;

1910.1200(g)(2)(xii)
Section 12, Ecological information;
1910.1200(g)(2)(xiii)
Section 13, Disposal considerations;
1910.1200(g)(2)(xiv)
Section 14, Transport information;
1910.1200(g)(2)(xv)
Section 15, Regulatory information; and
1910.1200(g)(2)(xvi)
Section 16, Other information, including date of preparation or last revision.

Note 1 to paragraph (g)(2): To be consistent with the GHS, an SDS must also include the headings in paragraphs (g)(2)(xii) through (g)(2)(xv) in order.

Note 2 to paragraph (g)(2): OSHA will not be enforcing information requirements in sections 12 through 15, as these areas are not under its jurisdiction.

1910.1200(g)(3)
If no relevant information is found for any sub-heading within a section on the safety data sheet, the chemical manufacturer, importer or employer preparing the safety data sheet shall mark it to indicate that no applicable information was found.

1910.1200(g)(4)
Where complex mixtures have similar hazards and contents (i.e. the chemical ingredients are essentially the same, but the specific composition varies from mixture to mixture), the chemical manufacturer, importer or employer may prepare one safety data sheet to apply to all of these similar mixtures.

1910.1200(g)(5)
The chemical manufacturer, importer or employer preparing the safety data sheet shall ensure that the information provided accurately reflects the scientific evidence used in making the hazard classification. If the chemical manufacturer, importer or employer preparing the safety data sheet becomes newly aware of any significant information regarding the hazards of a chemical, or ways to protect against the hazards, this new information shall be added to the safety data sheet within three months. If the chemical is not currently being produced or imported, the chemical manufacturer or importer shall add the information to the safety data sheet before the chemical is introduced into the workplace again.

1910.1200(g)(6)(i)
Chemical manufacturers or importers shall ensure that distributors and employers are provided an appropriate safety data sheet with their initial shipment, and with the first shipment after a safety data sheet is updated;

1910.1200(g)(6)(ii)
The chemical manufacturer or importer shall either provide safety data sheets with the shipped containers or send them to the distributor or employer prior to or at the time of the shipment;

1910.1200(g)(6)(iii)
If the safety data sheet is not provided with a shipment that has been labeled as a hazardous chemical, the distributor or employer shall obtain one from the chemical manufacturer or importer as soon as possible; and,

1910.1200(g)(6)(iv)
The chemical manufacturer or importer shall also provide distributors or employers with a safety data sheet upon request.

1910.1200(g)(7)(i)
Distributors shall ensure that safety data sheets, and updated information, are provided to other distributors and employers with their initial shipment and with the first shipment after a safety data sheet is updated;

1910.1200(g)(7)(ii)
The distributor shall either provide safety data sheets with the shipped containers, or send them to the other distributor or employer prior to or at the time of the shipment;

1910.1200(g)(7)(iii)
Retail distributors selling hazardous chemicals to employers having a commercial account shall provide a safety data sheet to such employers upon request, and shall post a sign or otherwise inform them that a safety data sheet is available;

1910.1200(g)(7)(iv)
Wholesale distributors selling hazardous chemicals to employers over-the-counter may also provide safety data sheets upon the request of the employer at the time of the over-the-counter purchase, and shall post a sign or otherwise inform such employers that a safety data sheet is available;

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

1910.1200(g)(7)(vi)
Wholesale distributors shall also provide safety data sheets to employers or other distributors upon request; and,

1910.1200(g)(7)(vii)
Chemical manufacturers, importers, and distributors need not provide safety data sheets to retail distributors that have informed them that the retail distributor does not sell the product to commercial accounts or open the sealed container to use it in their own workplaces.

1910.1200(g)(8)
The employer shall maintain in the workplace copies of the required safety data sheets for each hazardous chemical, and shall ensure that they are readily accessible during each work shift to employees when they are in their work area(s). (Electronic access and other alternatives to maintaining paper copies of the safety data sheets are permitted as long as no barriers to immediate employee access in each workplace are created by such options.)

1910.1200(g)(9)
Where employees must travel between workplaces during a workshift, i.e., their work is carried out at more than one geographical location, the material safety data sheets may be kept at the primary workplace facility. In this situation, the employer shall ensure that employees can immediately obtain the required information in an emergency.

1910.1200(g)(10)
Safety data sheets may be kept in any form, including operating procedures, and may be designed to cover groups of hazardous chemicals in a work area where it may be more appropriate to address the hazards of a process rather than individual hazardous chemicals. However, the employer shall ensure that in all cases the required information is provided for each hazardous chemical, and is readily accessible during each work shift to employees when they are in their work area(s).

1910.1200(g)(11)
Safety data sheets shall also be made readily available, upon request, to designated representatives, the Assistant Secretary, and the Director, in accordance with the requirements of § 1910.1020(e).

Employee Information and Training

1910.1200(h)(1)
Employers shall provide employees with effective information and training on hazardous chemicals in their work area at the time of their initial assignment, and whenever a new chemical hazard the employees have not previously been trained about is introduced into their work area. Information and training may be designed to cover categories of hazards (e.g., flammability, carcinogenicity) or specific chemicals. Chemical-specific information must always be available through labels and safety data sheets.

1910.1200(h)(2)
Information. Employees shall be informed of:
1910.1200(h)(2)(i)
The requirements of this section;
1910.1200(h)(2)(ii)
Any operations in their work area where hazardous chemicals are present; and,
1910.1200(h)(2)(iii)
The location and availability of the written hazard communication program, including the required list(s) of hazardous chemicals, and safety data sheets required by this section.

Training. Employee training shall include at least:

1910.1200(h)(3)(i)
Methods and observations that may be used to detect the presence or release of a hazardous chemical in the work area (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.);

1910.1200(h)(3)(ii)
The physical, health, simple asphyxiation, combustible dust, and pyrophoric gas hazards, as well as hazards not otherwise classified, of the chemicals in the work area;

1910.1200(h)(3)(iii)
The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used; and,

1910.1200(h)(3)(iv)
The details of the hazard communication program developed by the employer, including an explanation of the labels received on shipped containers and the workplace labeling system used by their employer; the safety data sheet, including the order of information and how employees can obtain and use the appropriate hazard information.

1910.1200(i)
Trade secrets.
1910.1200(i)(1)
The chemical manufacturer, importer, or employer may withhold the specific chemical identity, including the chemical name, other specific identification of a hazardous chemical, or the exact percentage (concentration) of the substance in a mixture, from the safety data sheet, provided that:
1910.1200(i)(1)(i)
The claim that the information withheld is a trade secret can be supported;
1910.1200(i)(1)(ii)
Information contained in the safety data sheet concerning the properties and effects of the hazardous chemical is disclosed;
1910.1200(i)(1)(iii)
The safety data sheet indicates that the specific chemical identity and/or percentage of composition is being withheld as a trade secret; and,
1910.1200(i)(1)(iv)
The specific chemical identity and percentage is made available to health professionals, employees, and designated representatives in accordance with the applicable provisions of this paragraph (i).
1910.1200(i)(2)
Where a treating physician or nurse determines that a medical emergency exists and the specific chemical identity and/or specific percentage of composition of a hazardous chemical is necessary for emergency or first-aid treatment, the chemical manufacturer, importer, or employer shall immediately disclose the specific chemical identity or percentage composition of a trade secret chemical to that treating physician or nurse, regardless of the existence of a written statement of need or a confidentiality agreement.

The chemical manufacturer, importer, or employer may require a written statement of need and confidentiality agreement, in accordance with the provisions of paragraphs (i)(3) and (4) of this section, as soon as circumstances permit.
1910.1200(i)(3)
In non-emergency situations, a chemical manufacturer, importer, or employer shall, upon request, disclose a specific chemical identity or percentage composition, otherwise permitted to be withheld under paragraph (i)(1) of this section, to a health professional (i.e. physician, industrial hygienist, toxicologist, epidemiologist, or occupational health nurse) providing medical or other occupational health services to exposed employee(s), and to employees or designated representatives, if:
1910.1200(i)(3)(i)
The request is in writing;
1910.1200(i)(3)(ii)
The request describes with reasonable detail one or more of the following occupational health needs for the information:
1910.1200(i)(3)(ii)(A)
To assess the hazards of the chemicals to which employees will be exposed;
1910.1200(i)(3)(ii)(B)
To conduct or assess sampling of the workplace atmosphere to determine employee exposure levels;
1910.1200(i)(3)(ii)(C)
To conduct pre-assignment or periodic medical surveillance of exposed employees;
1910.1200(i)(3)(ii)(D)
To provide medical treatment to exposed employees;
1910.1200(i)(3)(ii)(E)
To select or assess appropriate personal protective equipment for exposed employees;
1910.1200(i)(3)(ii)(F)
To design or assess engineering controls or other protective measures for exposed employees; and,
1910.1200(i)(3)(ii)(G)
To conduct studies to determine the health effects of exposure.
1910.1200(i)(3)(iii)
The request explains in detail why the disclosure of the specific chemical identity or percentage composition is essential and that, in lieu thereof, the disclosure of the following information to the health professional, employee, or designated representative, would not satisfy the purposes described in paragraph (i)(3)(ii) of this section:
1910.1200(i)(3)(iii)(A)
The properties and effects of the chemical;
1910.1200(i)(3)(iii)(B)
Measures for controlling workers' exposure to the chemical;
1910.1200(i)(3)(iii)(C)
Methods of monitoring and analyzing worker exposure to the chemical; and,
1910.1200(i)(3)(iii)(D)
Methods of diagnosing and treating harmful exposures to the chemical;
1910.1200(i)(3)(iv)
The request includes a description of the procedures to be used to maintain the confidentiality of the disclosed information; and,
1910.1200(i)(3)(v)
The health professional, and the employer or contractor of the services of the health professional (i.e. downstream employer, labor organization, or individual employee), employee, or designated representative, agree in a written confidentiality agreement that

the health professional, employee, or designated representative, will not use the trade secret information for any purpose other than the health need(s) asserted and agree not to release the information under any circumstances other than to OSHA, as provided in paragraph (i)(6) of this section, except as authorized by the terms of the agreement or by the chemical manufacturer, importer, or employer.
1910.1200(i)(4)
The confidentiality agreement authorized by paragraph (i)(3)(iv) of this section:
1910.1200(i)(4)(i)
May restrict the use of the information to the health purposes indicated in the written statement of need;
1910.1200(i)(4)(ii)
May provide for appropriate legal remedies in the event of a breach of the agreement, including stipulation of a reasonable pre-estimate of likely damages; and,
1910.1200(i)(4)(iii)
May not include requirements for the posting of a penalty bond.
1910.1200(i)(5)
Nothing in this standard is meant to preclude the parties from pursuing non-contractual remedies to the extent permitted by law.
1910.1200(i)(6)
If the health professional, employee, or designated representative receiving the trade secret information decides that there is a need to disclose it to OSHA, the chemical manufacturer, importer, or employer who provided the information shall be informed by the health professional, employee, or designated representative prior to, or at the same time as, such disclosure.

1910.1200(i)(7)
If the chemical manufacturer, importer, or employer denies a written request for disclosure of a specific chemical identity or percentage composition, the denial must:
1910.1200(i)(7)(i)
Be provided to the health professional, employee, or designated representative, within thirty days of the request;
1910.1200(i)(7)(ii)
Be in writing;
1910.1200(i)(7)(iii)
Include evidence to support the claim that the specific chemical identity or percent of composition is a trade secret;
1910.1200(i)(7)(iv)
State the specific reasons why the request is being denied; and,
1910.1200(i)(7)(v)
Explain in detail how alternative information may satisfy the specific medical or occupational health need without revealing the trade secret.

1910.1200(i)(8)
The health professional, employee, or designated representative whose request for information is denied under paragraph (i)(3) of this section may refer the request and the written denial of the request to OSHA for consideration.

1910.1200(i)(9)
When a health professional, employee, or designated representative refers the denial to OSHA under paragraph (i)(8) of this section, OSHA shall consider the evidence to determine if:

1910.1200(i)(9)(i)
The chemical manufacturer, importer, or employer has supported the claim that the specific chemical identity or percentage composition is a trade secret;
1910.1200(i)(9)(ii)
The health professional, employee, or designated representative has supported the claim that there is a medical or occupational health need for the information; and,
1910.1200(i)(9)(iii)
The health professional, employee or designated representative has demonstrated adequate means to protect the confidentiality.

1910.1200(i)(10)(i)
If OSHA determines that the specific chemical identity or percentage composition requested under paragraph (i)(3) of this section is not a "bona fide" trade secret, or that it is a trade secret, but the requesting health professional, employee, or designated representative has a legitimate medical or occupational health need for the information, has executed a written confidentiality agreement, and has shown adequate means to protect the confidentiality of the information, the chemical manufacturer, importer, or employer will be subject to citation by OSHA.

1910.1200(i)(10)(ii)
If a chemical manufacturer, importer, or employer demonstrates to OSHA that the execution of a confidentiality agreement would not provide sufficient protection against the potential harm from the unauthorized disclosure of a trade secret, the Assistant Secretary may issue such orders or impose such additional limitations or conditions upon the disclosure of the requested chemical information as may be appropriate to assure that the occupational health services are provided without an undue risk of harm to the chemical manufacturer, importer, or employer.

1910.1200(i)(11)
If a citation for a failure to release trade secret information is contested by the chemical manufacturer, importer, or employer, the matter will be adjudicated before the Occupational Safety and Health Review Commission in accordance with the Act's enforcement scheme and the applicable Commission rules of procedure. In accordance with the Commission rules, when a chemical manufacturer, importer, or employer continues to withhold the information during the contest, the Administrative Law Judge may review the citation and supporting documentation "in camera" or issue appropriate orders to protect the confidentiality of such matters.

1910.1200(i)(12)
Notwithstanding the existence of a trade secret claim, a chemical manufacturer, importer, or employer shall, upon request, disclose to the Assistant Secretary any information which this section requires the chemical manufacturer, importer, or employer to make available. Where there is a trade secret claim, such claim shall be made no later than at the time the information is provided to the Assistant Secretary so that suitable determinations of trade secret status can be made and the necessary protections can be implemented.

1910.1200(i)(13)
Nothing in this paragraph shall be construed as requiring the disclosure under any circumstances of process information which is a trade secret.

1910.1200(j)
Effective dates.
1910.1200(j)(1)
Employers shall train employees regarding the new label elements and safety data sheets format by December 1, 2013.
1910.1200(j)(2)
Chemical manufacturers, importers, distributors, and employers shall be in compliance with all modified provisions of this section no later than June 1, 2015, except:
1910.1200(j)(2)(i)
After December 1, 2015, the distributor shall not ship containers labeled by the chemical manufacturer or importer unless the label has been modified to comply with paragraph (f)(1) of this section.
1910.1200(j)(2)(ii)
All employers shall, as necessary, update any alternative workplace labeling used under paragraph (f)(6) of this section, update the hazard communication program required by paragraph (h)(1), and provide any additional employee training in accordance with paragraph (h)(3) for newly identified physical or health hazards no later than June 1, 2016.
1910.1200(j)(3)
Chemical manufacturers, importers, distributors, and employers may comply with either § 1910.1200 revised as of October 1, 2011, or the current version of this standard, or both during the transition period.

[59 FR 17479, April 13, 1994; 59 FR 65947, Dec. 22, 1994; 61 FR 5507, Feb. 13, 1996; 77 FR 17785, March 26, 2012]

Different Types of Chemical Hazards
Chemicals cause health hazards if they are:

Target organ chemicals—they injure specific organs in your body.
Toxic—cause illness or death. Toxic chemicals are determined on the basis of tests on laboratory animals that are exposed to a given chemical through either inhalation, ingestion, or skin absorption.
Corrosive—can destroy your skin or eyes.
Irritants—cause reversible inflammation when they make contact with living tissue.
Carcinogens—have been known to cause cancer or have the potential of causing cancer in humans.
Sensitizers—can cause an allergic reaction on subsequent repeated exposures.
Neurotoxins—produce toxic effects primarily on the central nervous system.
Nephrotoxins—Produce toxic effects on kidneys.
Reproductive toxins—have the potential to adversely affect the reproductive system.
Hepatotoxins—can adversely affect the liver.
Lung hazards—can irritate or damage pulmonary tissue.
Skin hazards—can affect the dermal layer of the body, resulting in rashes and irritation.
Eye hazards—can adversely affect the eye or diminish the visual capacity of a human.
Blood system hazards—caused by chemicals that decrease the hemoglobin function; depriving of oxygen. Chemicals that present physical hazards and are covered by the Hazard Communication Standard include combustible liquids, flammable materials, all compressed gases, explosives, organic peroxides, oxidizers, pyrophoric materials, unstable materials, and water-reactive materials.
Fire hazards—chemicals that have the potential for creating a fire or aiding an ongoing fire. These materials are flammables, combustibles, oxidizers, pyrophoric materials, and organic peroxides.
Flammables—catch fire quickly.
Oxidizers—capable of initiating or promoting a fire in other compounds by the release of oxygen or other gases.
Pyrophoric materials—can be ignited as a result of contact with oxygen in the absence of an ignition source at temperature below 130°F.
Organic peroxides—contain both fuel, in the form of carbon, and excess oxygen, and thus can pose a severe fire hazard.
Compressed gases—all compressed gases pose a physical hazard.
Explosive materials—can be decomposed in a violent chemical reaction with the production of heat, pressure, and large quantities of gas.
Unstable materials—certain compounds in their pure form can undergo vigorous decomposition or polymerization under moderate conditions of shock, pressure, or temperature.
Water-reactive compounds—can react vigorously with water to produce a toxic or flammable gas.

Identifying Hazardous Chemicals

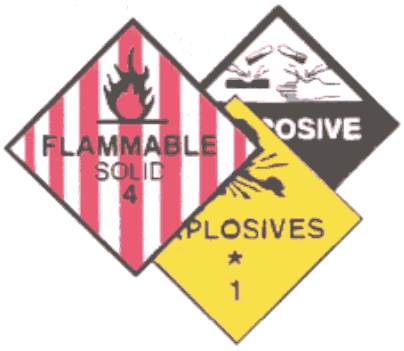
Chemical manufacturers have to let users know about hazards. They do this by providing, for each product, a container label which gives a quick overview of the chemical, and an SDS which offers more complete information.

Label Information
Hazardous chemical containers are labeled by the manufacturer. The label format may differ from company to company, but all labels must contain the same information. This makes it easy to determine at a glance a chemical's possible hazards and the basic steps that employees must take to protect themselves.

The label may use words or symbols to tell you:
The chemical's identity and its components (unless they're part of the manufacturer's trade secrets, which do not have to be revealed)
The name and address of the company that made or imported the chemical

Specific hazard warnings, such as physical or health hazards. Labels may also include:

- ✓ Precautionary measures, such as basic protective clothing, equipment, and procedures to work safely
- ✓ Proper handling and storage instructions
- ✓ First-aid instructions
- ✓ Special instructions concerning children



SDS Information
Each company should have on file an SDS for every chemical and hazardous product in the workplace. SDSs describe everything an employee needs to know about the chemical.

Employees must read the SDS before starting a job to know what they're working with and how to handle it safely. Though individual SDSs may give a different amount of information, they all contain similar types of information.

Fire, Explosion, and Reactivity Hazards

Some chemicals present physical hazards such as the potential for fire, explosion, and reactivity. The SDS explains these physical hazards.

Flammable chemicals—catch fire easily. The SDS will tell if it's flammable.

Flash point—the minimum temperature at which a liquid gives off enough vapors to burn. The lower the flash point, the more flammable the substance.

Flammable limits—the range of concentration of a substance in the air within which a substance can readily catch fire. Concentrations below or above the limits are less likely to ignite or burn.

CHLORINE

DO NOT TAKE INTERNALLY

AVOID CONTACT WITH EYES, MOUTH OR CLOTHING

WARNING

AVOID BREATHING FUMES

FLAMMABLE - KEEP FIRE AWAY

USE ONLY IN WELL VENTILATED AREAS.
USE ONLY WHERE THERE ARE NO OPEN FLAMES OR OTHER SOURCES OF IGNITION

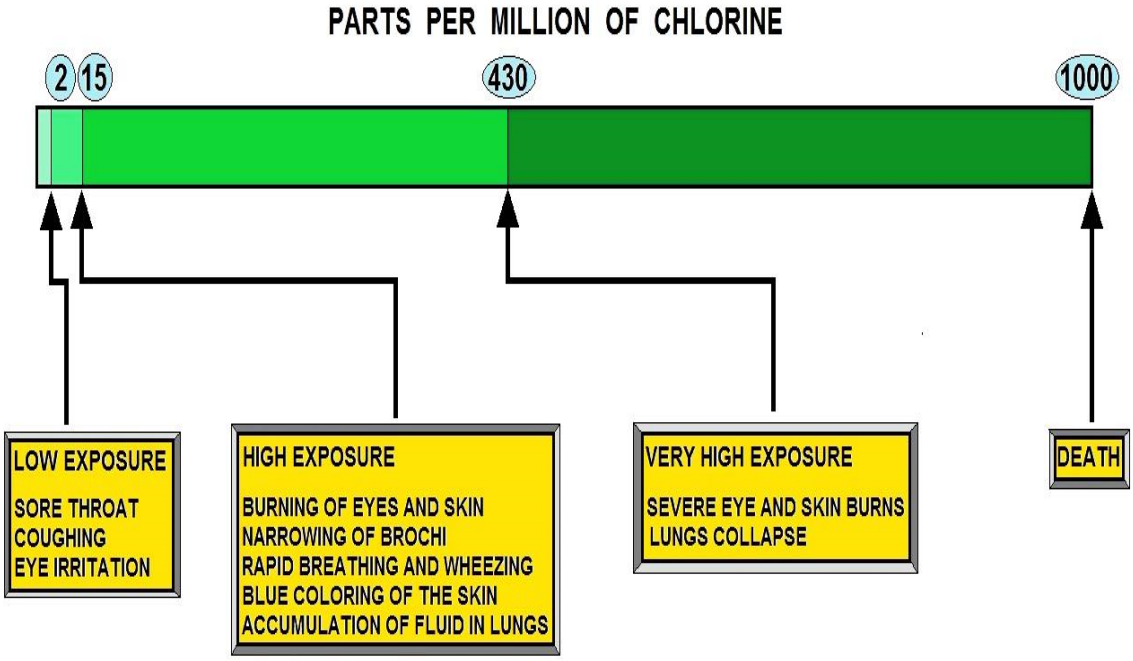
EXTREMELY FLAMMABLE
KEEP AWAY FROM HEAT, SPARKS AND OPEN FLAME
KEEP CONTAINER CLOSED

HAZARD IDENTIFICATION

CODE NUMBERS

4 - SEVERE
3 - SERIOUS
2 - MODERATE
1 - SLIGHT
0 - MINIMAL

SYMPTOM OF CHLORINE POISONING:
DIFFICULTY IN BREATHING, ACCUMULATION IN LUNGS
BURNING SENSATION IN MOUTH, THROAT SWELLING
THROAT AND STOMACH PAIN, VOMITING
ACIDITY LEVELS IN BODY CHANGE, LOW BLOOD PRESSURE
BURNING AND IRRITATION OF EYES, TEMPORARY LOSS OF VISION
TISSUE DAMAGE, BURNS AND IRRITATION OF THE SKIN



EFFECTS OF CHLORINE GAS ON HEALTH

Highly Toxic Chemicals

Acutely toxic chemicals are substances falling into any of the following categories:

- A chemical that has a median lethal dose (LD50) of 50 mg or less per kg of body weight, when administered to albino rats weighing 200 to 300 g each.

- A chemical that has a median lethal dose (LD50) of 200 mg or less per kg of body weight, when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) to the bare skin of albino rabbits weighing 2 and 3 kg each.

- A chemical that has a median lethal concentration (LC50) in air of 200 parts per million by volume or less of gas or vapor, or 2 mg per liter or less of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing 200 to 300 g each.

Handling Procedures Policy Example
For the cases of substances that present special hazards, the following procedures will be used to minimize risk. These procedures must be followed in laboratory operations with substances believed to be highly toxic or carcinogenic, even when used in small amounts. The extent of precaution depends on the hazards of the particular substance.

Factors such as physical form and volatility of the substance, type and duration of exposure, and the amount to be used should be considered.

All plans for experimental work and waste disposal must be approved by the laboratory supervisor in consultation with the Departmental Chemical Hygiene Officer or equivalent.

The overall objective is to minimize exposure to toxic substances, by any route of exposure. The general precautions outlined elsewhere in this plan should normally be followed whenever a toxic substance is transferred from one container to another or is subject to some chemical or physical manipulation.

The following procedures must also always be followed:

Record Keeping
Accurate records that include the amounts of chemicals used and names of researchers or employees involved should be kept as part of the laboratory notebook record of the experiment.

Storage
Substances having high chronic toxicity should be stored in a well ventilated area in a secondary container or tray.

Labels and Signs

All containers in the high chronic toxicity category will include a warning such as: **WARNING! CANCER SUSPECT AGENT**. All newly purchased containers should already contain this warning, but batch containers and solutions must also be labeled. Any area used for storage should have a label identifying the special toxicity hazard that exists.

Designated Areas
All experiments with and transfers of particularly hazardous substances or mixtures containing such substances must be done in a designated area. A designated area is defined as a laboratory, a portion of a laboratory, or a facility such as an exhaust hood or glove box that is designated for the use of highly toxic substances. Its use need not be restricted if all personnel who have access to the controlled area are aware of the nature of the substances being used and the precautions that are necessary.

Designated areas will be clearly marked with a conspicuous sign such as the following**:**

WARNING!
HIGHLY TOXIC SUBSTANCE IN USE: AUTHORIZED PERSONNEL ONLY.

The working surface of the hood can be fitted with a removable liner of absorbent material. Surfaces can be protected from contamination with chemically resistant trays or plastic backed disposable paper.

Protective Equipment
In some cases, the laboratory supervisor may deem it advisable to wear special protective equipment when working with particularly hazardous substances.

Examples include long gloves or an apron covered by a disposable coat.

Clearly identify the hazardous waste material with the proper label.

Decontamination

On leaving a controlled area, remove any protective apparel, thoroughly wash hands and arms, face, and neck. If disposable apparel or absorbent paper has been used, place these items in a closed impervious bag or container for disposal. Work surfaces will be thoroughly washed and rinsed.

All equipment that is known or suspected to have been in contact with particularly hazardous substances will also be washed and rinsed.

Waste Disposal
All general waste disposal procedures will be followed. Certain additional precautions must also be observed when waste materials are known to contain amounts of highly toxic substances. Volatile toxic substances must never be disposed of by evaporation in the hood. If practical, waste materials should be decontaminated as the last step in the experiment by some procedure that can reasonably be expected to convert the toxic substance to nontoxic substances.

Consult ***Prudent Practices for Disposal of Chemicals from Laboratories*** (available in EHS Office) for specific destruction procedures. If decomposition is not feasible, the waste will be stored in closed, impervious containers such that personnel handling the containers will not be exposed to its contents. All waste containers must be labeled to indicate the contents (constituents and approximate amounts or percentages) and the type of hazard that contact may pose.

For instance, if a waste stream is known to contain appreciable amounts of a carcinogen, the container should be labeled: **CANCER SUSPECT AGENT**. The generation of acutely hazardous waste (**P-waste**) must be closely monitored. As a small quantity generator, generally, laboratories are allowed to store no more than 1 kg (2.2 lbs.) of acutely hazardous waste. All wastes and residues that have not been chemically decontaminated will be disposed of in accordance with your Laboratory's Hazardous Waste Procedures.

Medical Consultation
An opportunity to receive medical consultation shall be provided under the following circumstances:

- If an employee develops signs or symptoms associated with a hazardous chemical to which they may have been exposed,
- There has been a spill, leak, explosion, or other occurrence in the work area resulting in the likelihood of a hazardous exposure, or
- If exposure monitoring reveals that a PEL or action level is routinely violated for any OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.

Laboratory employees may receive medical attention through Workers' Compensation. Contact the Human Resources Department to fill out an injury report.

In addition, employees who need to wear respirators to control chemical exposure must have a medical examination prior to wearing the respirator to ensure that they are physically able to wear one.

Wastewater sludge samples with chain of custody paperwork. Do not eat near these samples and always wash your hands. I have seen several lab techs eat with one hand while touching samples with the other hand. Always wear gloves also. I can tell you story after story of personnel that will not wear gloves.

Are you prepared for a biological spill?

Spills and Emergency Procedures Policy Example

Chemical Spills
The time to prepare to handle a spill is long before it occurs. Appropriate precautions and the proper equipment will alleviate many of the potential complications associated with the spill of a hazardous material. The following principles will decrease the likelihood of a spill:

- Substitute a less hazardous chemical, procedure, or piece of equipment such as alcohol thermometers instead of mercury thermometers.
- Always store chemicals containers with closed caps.
- Use secondary containment whenever possible. Trays and wash basins work well. Coated safety bottles should be used when possible.
- Do not store chemicals on the floor, desks, or counter tops.
- Check shelving; watch for overloading or overcrowding. Excess chemicals can be stored in the division stockroom.
- Practice good housekeeping. Clutter increases the likelihood of a spill or accident.
- Minimize chemical storage in the laboratory. Purchase only the amount needed.

Anticipate chemical spills by having appropriate cleanup and safety equipment on hand.
These cleanup supplies should be consistent with the hazards and quantities of substances used.
Paper towels and sponges may be used as absorbent type cleanup aids but this should be done cautiously. Paper used to clean up oxidizers can later ignite and appropriate gloves should be worn when cleaning toxic materials with towels. Sponges should be chemical resistant.
Commercial clean-up kits are available that have instructions, absorbents, neutralizers, and protective equipment, but these kits are usually expensive and may not cover everything used in a particular lab. Individuals or departments may want to assemble their own kits. The EHS Office can offer assistance in this process. These kits should be located strategically around the laboratory or department area.

If a spill does occur, the following general procedures should be followed:

- Attend to contaminated personnel.
- Alert personnel in adjacent areas.
- Confine the spill, and evacuate nonessential personnel from spill area.
- If spilled material is flammable, extinguish flames and all other sources of ignition.
- Maintain fume hood ventilation.
- Secure appropriate cleanup supplies.
- During cleanup, wear appropriate personal protection.
- Notify the Supervisor of Chemical Management, if the spill involves a regulated substance.

When the nature of the spill constitutes a more serious hazard or involves the release of gas or fumes, the following procedures should be followed:

- Activate the emergency alarm system.
- Rescue injured personnel, if possible.
- Evacuate the building; move to the assembly area.
- Notify Security with the details of the situation.

Emergency Procedures
All laboratory personnel must be familiar with the Emergency Response Plan. The following additional procedures are intended to limit injuries and minimize damage should an accident occur:
Render assistance to persons involved and remove them from exposure to further injury, if necessary.

- Warn personnel in adjacent areas of potential hazards to their safety.
- Render immediate first aid such as washing in safety shower, administering CPR, or special first aid (such as the use of a cyanide kit if cyanide exposure is involved).
- Extinguish small fires by using a portable fire extinguisher. Turn off nearby apparatus and remove flammable materials from the area. In case of larger fires, contact Security immediately.

In the case of a medical emergency, remain calm and do only what is necessary to protect life.

- Call Security immediately.
- Do not move an injured person unless they are in further danger.
- Keep the injured person warm. If feasible, designate one person to remain with the injured person.
- If clothing is on fire, knock the person on the ground and roll them around to smother the flames, or douse under a safety shower. A fire blanket should only be used as a last resort.

Fires and Explosions Policy Example
Small fires can easily be extinguished without evacuating the building or calling the fire department. However, even a small fire can quickly become a serious problem. The first few minutes are critical to preventing a larger emergency. The following actions should be taken by personnel in the event of a minor fire:

- Alert other people in the laboratory and send someone to call Security.
- Attack the fire immediately, but never attempt to fight a fire alone. A fire in a small vessel can often be suffocated by placing a larger beaker or watch glass over the top. Use the proper extinguisher, directing discharge of the extinguisher at the base of the flame:
    - ***class A fires*** - ordinary combustible solids such as paper, wood, rubber, and textiles.
    - ***class B fires -*** petroleum hydrocarbons and volatile flammable solvents.
    - ***class C fires -*** electrical equipment.
    - ***class D fires*** - combustible or reactive metals such as sodium, potassium, or magnesium, metal hydrides, or organometallics.
    - Avoid entrapment, always fight a fire from a position accessible to an exit.

If there is any doubt whether the fire can be controlled locally by available personnel or equipment, the following actions should be taken:

- Activate the emergency alarm system.
- Confine the fire (close hood sashes, doors between laboratories, and fire doors) to prevent further spread of the fire.
- Assist injured personnel.
- Evacuate the building; move to an assemble point for accountability.

Personal Contamination Clean-up Procedures

Chemical Spill to a Large Portion of the Body

- Immediately flood the contaminated area with sufficient running water.
- Remove all contaminated clothing.
- Continue to rinse with cold water for 15 minutes. Wash chemical from contaminated areas with the water but do not apply creams or lotions.
- Get medical attention promptly.

Chemicals on the Skin in a Confined Area

- Flush the exposed skin with cold water.
- If the skin is not burned, wash the area with soap.
- Seek profession medical attention if necessary.

Chemical in the Eyes

- Flush the eyeball and inner eyelid with cold water for 15 minutes. Forcibly hold the eye open to wash thoroughly behind the eyelids.
- Get profession medical attention promptly.
- For caustic splash, continue to irrigate during transportation.

For Contact Lenses

- Copiously irrigate the eye with irrigation solution or water (do not use neutralizing solutions) while holding the lids apart as described above.
- Do not worry about losing the contact lens.
- If the lens remains after the initial flushing, remove it or slide it onto the conjunctiva and re-irrigate.
- Seek professional emergency management. Let them know if the contact lenses are still in the eyes.

Smoke or Fume Inhalation

- Remove from the contaminated air to fresh air.
- Treat for shock, if necessary.
- Get professional medical attention promptly.

Chemical Ingestion

- Administer antidote, if known and available.
- Wrap in blanket to prevent shock.
- Notify Security.
- Identify the chemical(s), and obtain the SDS for the hospital.

EMERGENCY RESPONSE TO CHEMICAL SPILLS AND/OR RELEASES *Policy Example*

Each department, shop, laboratory, studio, or work area must have an Emergency Response Plan which includes the appropriate site specific procedures and response equipment for dealing with a chemical spill. It is the responsibility of each individual using chemicals and chemical products to become familiar with this plan. The following general rules should be followed in the event of an emergency:

1. ACTIVATE ALARMS, IF NECESSARY.
Be familiar with the location of the alarm system in your area. If the incident could threaten the health of the individuals in the building, **activate the alarm**.

2. TREAT LIFE THREATENING INJURIES. FOR INGESTION OR INHALATION, CALL THE POISON CONTROL CENTER 1-800-252-5655.
The first priority in the event of an emergency is to protect the life and health of individuals whenever possible. **Do not unnecessarily jeopardize your own safety**. Know the location of emergency showers and eyewashes.

3. EVACUATE NON-ESSENTIAL PERSONNEL AND PREVENT ACCESS TO THE AREA.
Barricades of some sort with appropriate warnings should be set up to prevent inadvertent access to the area of the spill. This action may be necessary to prevent injury and to control the spread of contamination.

4. DIAL 911 TO INITIATE OUR EMERGENCY RESPONSE PLAN OR CALL SECURITY FOR NON-EMERGENCY SITUATIONS.
Get as much information as you can about the chemical or chemical products. If possible, locate the Safety Data Sheet (SDS). Be sure that everyone involved is accurately informed as to the nature and location of the spill.

5. CONTAIN THE SPILL IF IT CAN BE DONE SAFELY AND PREVENT RELEASE TO THE ENVIRONMENT.
If the spill can safely be contained, prevent release to the sanitary sewer (sinks, drains), the storm sewer system, and/or the ground. **Do not unnecessarily jeopardize your own safety**.

6. INITIATE MATERIAL SPECIFIC CLEAN-UP PROCEDURES.
The Fire Department will respond to the immediate emergency and stabilize the situation, if necessary. However, eventual spill clean-up and disposal of the residue is the responsibility of the Laboratory and may be charged to the department(s) involved.

Check Safety Data Sheets (SDS) for proper spill clean-up methods and precautions. Clean up will probably require a level of protection greater than normal use.

NOTE: The best response to a spill or release is to know the properties of the materials that you are working with and to have a plan and the necessary clean-up equipment in the event of a spill.

Hazardous Waste Planning and Purchases Policy Example

It is your responsibility as generators of hazardous waste to make every attempt possible to minimize the amount produced.

To the extent that chemicals can be recovered, recycled, or reused safely there is obvious economic incentive to do so. In addition, materials that are recovered, recycled, or reused do not become a liability problem or a problem for the environment.

The planning of every purchase must include the consideration of the disposal of leftover starting materials and of the products and by-products that may be generated as a result of usage of a hazardous material. Questions to be considered include the following:

- **Can any material be recovered, reused, or recycled?**
- **Will the experiment produce an acutely hazardous waste?**
- **Can any unusual disposal problem be anticipated?**
- **Are materials being acquired in only the quantities needed? Are any of the materials already on site (in another location)?**
- **Is there the possibility of replacing a hazardous material or solvent with one with is less hazardous or more easily disposed of?**

Hazardous materials should be purchased in the smallest possible volumes to reduce the amount of unused chemicals that could end up as wastes. As the cost of chemicals and disposal continues to climb, any reduction in volume of chemicals purchased will offer benefits. Keep in mind that the perceived economy of buying in bulk is more than offset by disposal costs for the package and its residues.

2. Recovery and Recycling
The recycling process is exempt from hazardous waste regulation except that waste accumulated prior to recycling must be managed according to accumulation requirements.

Distillation is an example of a viable recovery option. All residues such as still bottoms from the recycling process are regulated and must be managed as hazardous waste.

Photographic fixer solutions cannot be discharged to the sink and will be collected for silver recovery. Other candidates for recycling include batteries, precious metals, scrap metals, waste oil, and formaldehyde.

Every effort must be made to determine if other materials can be reused, recovered, or recycled.

3. Hazardous Waste Identification
The first step in hazardous waste management comes when the two following questions must be answered:

1. **Is this material a waste?**
2. **Is this waste a regulated hazardous waste?**

The hazardous waste regulations apply to materials only when they become a waste and only if they are deemed hazardous under specific evaluation criteria.

4. Hazard Determination
Once you determine that a chemical material is a waste, it must be evaluated to determine if it is a hazardous waste. Wastes can be hazardous in one of two ways: they are either wastes or spent materials that are hazardous by definition and contained in specific lists, or they exhibit one of four hazardous characteristics: ignitability, corrosivity, reactivity, or toxicity.

a. Listed Wastes
Wastes that are hazardous because they appear on one of four lists are called "**listed hazardous wast**es". The four lists are categorized as wastes from specific sources (**K-list**), wastes from non-specific sources (**F-list**), certain discarded commercial products (**U-list**), and "**acutely hazardous**" commercial chemical products (**P-list**).

The F and K lists apply to general processes, while the U and P lists are for reagent chemicals. The P-list category which contains wastes such as cyanides is more rigorously regulated. If you are a SQG, your laboratory cannot generate more than 1 kg/month or store more than 1 kg of waste from the P-list.

Generation of acutely hazardous waste must be closely monitored. Mixtures of hazardous and non-hazardous waste are regulated as hazardous waste. So please segregate hazardous and non-hazardous materials whenever possible.

b. Characteristic Wastes
If a waste is not on one of the lists of hazardous wastes, you must determine if the waste possesses one or more of four hazardous characteristics defined below: **ignitability, corrosivity, reactivity, or toxicity**.

Such wastes are called "**characteristic hazardous wastes**". A generator may use his knowledge based on the materials or processes used or may test the waste to determine if it possesses one of the four characteristics. Personnel who generate chemical waste should have enough general knowledge of the hazardous characteristics of their waste to classify it.

Ignitability

- a liquid, other than an aqueous solution containing less than 24 percent alcohol by volume, with a flash point below 140 degrees F (60 C).
- a non-liquid, which under standard conditions is capable of causing fire through friction, absorption of moisture, or spontaneous chemical changes and when ignited, burns in a manner that creates a hazard
- an ignitable compressed gas, which includes gases that form flammable mixtures at a concentration of 13 percent or less in air
- an oxidizer, such as permanganate, inorganic peroxide, or nitrate, that readily stimulates combustion of organic materials.

Reactivity

- normally unstable and readily undergoes violent change without detonation.
- reacts violently with water.
- forms potentially explosive mixtures with water
- generates, when mixed with water, toxic gases, vapors, or fumes in a quantity sufficient to present a danger.
- is a cyanide or sulfide bearing waste that generates toxic gases, vapors, or fumes at a pH between 2 and 12.5.
- is capable of detonation or explosive reaction when subject to a strong initiating source or heated in confinement
- is readily capable of detonation, explosive decomposition, or reaction at standard temperature and pressure.
- is an explosive

Corrosivity

- is aqueous and has a pH less than or equal to 2 or greater than or equal to 12.5.
- is a liquid that corrodes steel at a rate greater than 6.35 mm per year at a test temperature of 130 degrees F (55 C).

Toxicity

- tested using the Toxicity Characteristic Leaching Procedure (**TCLP**), which stimulates the leaching of materials in a landfill into the surrounding groundwater.

Good sources for assistance in hazard determination are SDSs, chemical dictionaries, and labels.

5. Accumulation

An important step in the chemical disposal sequence involves the temporary storage of waste at or near the point of generation. Except when single chemicals are accumulated for recycling or recovery, waste accumulation generally involves bulking several materials into one container.

Please adhere to the following guidelines for safe accumulation of chemical waste:

- Label containers with words that clearly identify the contents the FIRST time waste is put into them.
- Separate incompatible wastes streams.
- Keep waste collection containers closed at ALL times during storage except when adding or removing waste. This is true for solids as well as liquids.
- Designate an area as a chemical waste accumulation area.

Some chemical products that are not regulated as hazardous waste can be disposed of in the sanitary sewer or normal trash. The decision to use one of these methods of disposal must be made after careful consideration of the consequences.

Sink Disposal Policy Example
Sinks and most drains on campus are connected to the local sanitary sewer system with the effluent eventually going to the Wastewater Treatment Facility. Materials that cannot be disposed of via the sanitary sewer are materials that interfere with the treatment systems or chemicals that may cause a danger to the system or human health. These chemicals include but are not limited to:

- Any substance that alone or by interaction with other substances can cause fire or explosion. Prohibited materials include but are not limited to: solvents and alcohols, peroxides, oxidizers, sulfides, hydrides, carbides, chlorates, perchlorates, bromates, carbides, ethers, gasoline, kerosene. Generally this includes wastes that would be characterized as ignitable.
- Solid or viscous substances that may cause obstruction to the flow such as garbage, animal guts or tissues, hair, bones, feathers, sand, metal, glass, straw, plastics, wood, rags, oil, grease, or paper.
- Waste having a pH less than 5.0 or greater than 9.5. Wastewater with corrosive properties capable of causing damage or hazard to structures, equipment, or personnel at the treatment plant.
- Waste containing toxic substances in sufficient quantity to interfere with the wastewater treatment process, constitute a hazard to humans or animals, or create a toxic effect in the receiving waters.
- Any noxious or malodorous liquids, gases, or solids.
- Heavy metals.
- Waste of objectionable color such as dyes or stains.
- Waste with temperature that inhibits biological activity (exceeding 104^{o} F).
- Any cyanide in excess of 2 mg/l by weight as CN.

a. Sink Disposal Procedures

- Drain disposal will be only into a drain that is connected to the wastewater treatment plant, never into a storm sewer drain that flows directly to surface water.
- The quantities of chemicals disposed of in the drain must be limited generally to not more than a few hundred grams or milliliters.
- Flush with at least 100 fold excess of water at the sink.
- Supervisors must monitor disposal for adherence to guidelines on type, quantity, rate, and flushing procedures.

7. Trash Disposal Policy Example
Non-hazardous solids can be disposed of in the trash (no liquid wastes are allowed in the landfill). As mentioned before, the decision to use the trash must be made after careful consideration of the consequences.

Non-hazardous materials will create a hazard if solid particles are inhaled or reach the eyes. A custodian may come in contact with it when he or she empties the trash. Our grounds crew could be exposed to the material when they handle the trash and compact it in the truck. All of our solid waste goes to a Landfill and will be there essentially forever. Do not dispose of chemicals loosely in the trash. Minimize potential for exposure by encasing non-hazardous chemicals in bags, boxes, or containers. Never dispose of large amounts of non-hazardous chemicals in the trash. Broken glass should be collected in puncture resistant containers and disposed of in such a way as to protect custodians and the grounds crew.

Empty containers that once held a hazardous material will be rinsed clean to remove any residue. All residue containing hazardous waste will be managed as such.

Substances known to be toxic will not be disposed of in the trash even if they are not regulated as hazardous waste.

Regulated Medical Waste (RMW)
Handling And Disposal Procedures

What is a Regulated Medical Waste?
Cultures and stocks of infectious agents such as tissue culture materials including human and primate cell lines, human blood and blood products, impure animal cell lines, preparations made from living organisms and their products, including vaccines, cultures, etc. intended for use in diagnosing, immunizing, or treating human beings or animals, or in research pertaining thereto.

"Infectious Agents" mean any organisms such as a virus or a bacteria that cause disease or an adverse health impact to humans. Those organisms found in Biosafety Levels 2 through 4 of the CDC's Manual for Biosafety in Microbiological and Biomedical Laboratories (May 1993) are included.

Culture media such as agar gel, nutrient broth, discarded media from cultures, and blood agar.

Clean up materials including absorbents, paper towels from culture/stock mixing.

Biologicals include preparations made from living organisms and their products, such as serums, vaccines, antigens, and antitoxins.

Culture dishes, flasks, or other devices used to transfer, inoculate, and mix culture dishes such as tissue culture plates, assay plates, test tubes, centrifuge tubes, cotton swabs, pipettes, pipette tips, stirring apparatus, flasks, vials, beakers, bottles, jars, spatulas, inoculation loops, wires, corks, stoppers, cell scrapers, cell lifters, paraffin sealing paper, foil, cotton, filters, mixing sticks, tubing, etc. that have been in contact with infectious materials.

Sharps means discarded unused sharps and sharps used in animal or human research. Examples include glassware such as Pasteur pipettes, glass, glass culture dishes, blood vials, glass beakers, glass flasks, glass test tubes, slides, cover slips, etc. in contact with infectious materials. Plasticware including broken rigid plastic items, broken plastic culture dishes/flasks, plastic pipettes, etc. in contact with infectious materials.

Syringes to include hypodermic needles and other materials capable of puncturing such as scalpel blades, suture needles, surgical needles, lancets, staples, instruments designed for cutting or puncturing: saws, tweezers, scissors, etc.

Animal waste means discarded materials including carcasses, body parts, fluids, blood, or bedding originating from animals known to be contaminated with infectious materials. Please evaluate the biological materials that you are using to ensure that no RMW is being disposed of in the regular solid waste. The enclosed list from the New York State Department of Environmental Conservation contains the CDC and NIH listing of infectious materials. Anything on the list must be handled and managed as a RMW.

Segregation Requirements
RMW must be segregated into the following three categories: **sharps**, **fluids** (greater than 20 cc), and **other RMW**.

Sharps will be collected for disposal in leak-proof, rigid, labeled, red puncture resistant containers that are secured to preclude loss of contents. Small (1 quart) and large (2 gallon) sharps containers are available from the Environmental Health and Safety Office.

Other RMW (non-sharps) will be collected in bags which are impervious to moisture and have strength sufficient to resist ripping, tearing, or bursting under normal conditions of usage and handling. The bags shall be secured to preclude loss of contents and will be red in color.

RMW will be collected in each laboratory that generates it. Laboratories will not store more than one full sharps container and/or red bag at any one time.

When full, the sharps containers and/or RMW bags will be brought to the EHS Office for storage in the storage area prior to pick up by a licensed company for incineration. The sharps containers will be replaced with new empty containers at the time of transfer.

Non-infectious biological organisms and associated lab debris should be autoclaved prior to disposal in the regular trash. Use clear auto-clavable bags.

Red or orange biohazard bags cannot be placed in the regular solid waste.

Chemical Hygiene Plan Example

1. 0 Purpose

The purpose of this program is to ensure that the laboratory chemical fume hoods used at your employer's facility are functioning in a manner capable of providing protection for the staff members who use them. This program is part of the Chemical Hygiene Plan that conforms to the recommendations in OSHA's Laboratory Standard.

2.0 Responsibilities

2.1 Environmental Health and Safety (EHS) Coordinator

- Ensure that hoods are evaluated at least annually.
- Inspect sashes, lights, service fixtures, interior, baffles, telltale, and cabinets in conjunction with annual face velocity measurements.
- Provide information to users on guidelines and operating procedures for safe use of hoods.
- Label hoods with certification stickers, sash arrows, and work practices guide.
- Coordinate with Building Maintenance for required maintenance items.

2.2 Department Chemical Hygiene Officers (DCHOs)

- Provide reinforcement of operating procedures and safe use information to department users.
- Establish department specific policies and procedures as necessary.
- Conduct periodic spot checks to ensure proper hood configuration and usage.
- Coordinate modifications, maintenance, repair, and new equipment needs with EHS and/or Building Maintenance.

2.3 Building Maintenance (BM)

- Coordinate for contractor to conduct annual face velocity measurements in accordance with this program.
- Perform preventive maintenance on fans, ductwork, and hoods.
- Perform repairs or maintenance identified by annual inspections or by users.
- Notify EHS and coordinate with users when hoods must be turned off for repair, maintenance, or other operations.

2.4 Hood Users

- Use hoods according to recommended guidelines for safe use.
- Do not modify hoods (to include baffle adjustment) without prior approval from EHS or BM.
- Submit work orders for maintenance items or repair to BM.

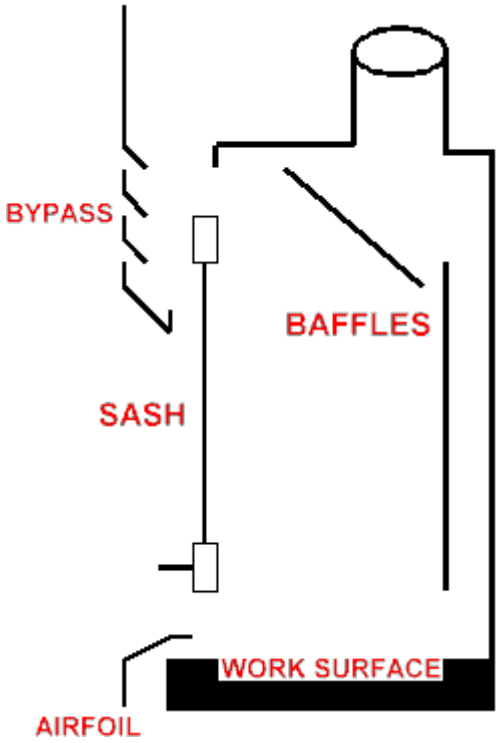
3.0 Hood Components

3.1 Airfoil - found along the bottom and sometimes side edges, airfoils streamline airflow into the hood preventing turbulent eddies at the face that can carry vapors out of the hood. Bottom airfoils also provide a space for room airflow when the sash is completely closed.

3.2 Baffles - moveable or adjustable partitions used to create slotted openings along the back of the hood body. Baffles help to keep a uniform airflow across the face of the hood, which eliminates dead spots and optimizes capture efficiency.

3.3 Sash - a moveable, see through barrier that closes or opens the face of the hood.

3.4 Work Surface - generally a laboratory bench top or floor in the case of a walk in hood. The area under the hood where apparatus and equipment is placed. Caution must be exercised if the work surface or hood body is made of transite, an asbestos containing material.



3.5 Bypass - grill opening above face of hood that helps to maintain a constant face velocity independent of the sash position. When the sash is lowered air flows in through the bypass and the hood face. When the sash is raised it blocks the bypass.

4.0 Background

Laboratory fume hoods are one of the most important components used to protect laboratory personnel from exposure to hazardous chemicals and agents used in the laboratory. When used properly, they can provide an effective backup safety device for the containment and exhaust of toxic, offensive, or flammable materials when the containment of an experiment or procedure fails and vapors or dusts escape from the apparatus being used. Chemical fume hoods may not provide protection from highly toxic (LD_{50} <5 mg/kg) or highly reactive materials. Operations involving these materials must be carried out in a glove box or other closed system.

Average face velocity is the main criterion that is used to determine if a hood is functioning satisfactorily as a safety device for the containment and elimination of airborne contaminants. The face of a hood is the plane of the opening into the hood. The velocity of air moving past the face is the face velocity, usually measured in feet per minute. The averaged value of the velocity of air moving into the hood at a set number of points across the face is the average face velocity.

Factors that can affect face velocity and thus hood performance include baffle position, cross drafts, air volume, hood features, hood location, foot traffic, and user work practices.

Recommended face velocities range from 60 fpm to 150 fpm. It is agreed that too high a face velocity can be detrimental to performance and user protection. Further compounding the situation is the fact that several different types, models, and sizes of hoods are in use at your employer.

Also, each building has an unique HVAC system that has been added to or otherwise modified over time. In light of this, your employer facility has established standards that are within the recommended range, are reasonably achievable, and should provide protection to users who employ the correct operating procedures. See the section on certification procedures for more details.

Initial fume hood inventory information was also compiled as part of this program. Information collected includes room numbers, hood face area, hood manufacturer and model, hood features, type of hood, hood lining material, storage cabinet type and ventilation, and sash height and width. Each hood was then assigned an unique identification number.

Laboratory fume hoods are one of the most important components used to protect laboratory personnel from exposure to hazardous chemicals and agents used in the laboratory.

5.0 Certification Procedures Policy Example

5.1 Chemical Fume Hoods

Chemical fume hoods should be evaluated annually according to the following:

Criterion	Standard
Instrument	Hot wire anemometer calibrated according to manufacturer's recommendations.
Grids	At least six; no greater than "12 x 12" in size.
Average Face Velocity	100 fpm +/-10 fpm.
Sash Height	Sash at stop; 17" above airfoil if no stop; 16" above hood surface if no airfoil.
Range	No measurement <10% of average; <15% variation point to point.
Baffles	Hamilton hoods should be in position A; adjust for uniform flow if necessary.
Maintenance	Inspect sash, light, fan belts, motor, ductwork, service fixtures, interior, baffles, cabinets, alarm or flow gauge (if applicable), telltale, guide sticker.
Smoke	Use if necessary to troubleshoot hood that doesn't meet standard.

Each fume hood will either pass or fail the annual certification. Hoods that pass will be labeled in the upper left hand corner with the hood number, average face velocity, and date of test. The hood may also be labeled with green arrows indicating the sash height that should not be exceeded. The EHS Coordinator, BM personnel, DCHO, and user(s) will meet to determine actions to be taken on hoods that fail the annual certification.

5.2 Laminar Flow Hoods

Laminar flow hoods also called clean benches should not be confused with chemical fume hoods. Laminar flow hoods are designed to protect biological specimens and material by bathing the work area with particle free air. The clean benches are not designed to contain hazardous vapors and gasses. As such, flammable and toxic substances must be used in a chemical fume hood, not a laminar flow hood.

Clean benches force air out the back of the unit, across the work surface and toward the researcher. The air is re-filtered (of particles only) before being exhausted back into the lab, not to the outside as with a fume hood. Laminar flow hoods will not be used for materials that would not be ordinarily be used on an open bench.

Our laminar flow hoods will be certified annually by an outside contractor according to the manufacturer's specifications. A certification label will be placed on the front of the hood.

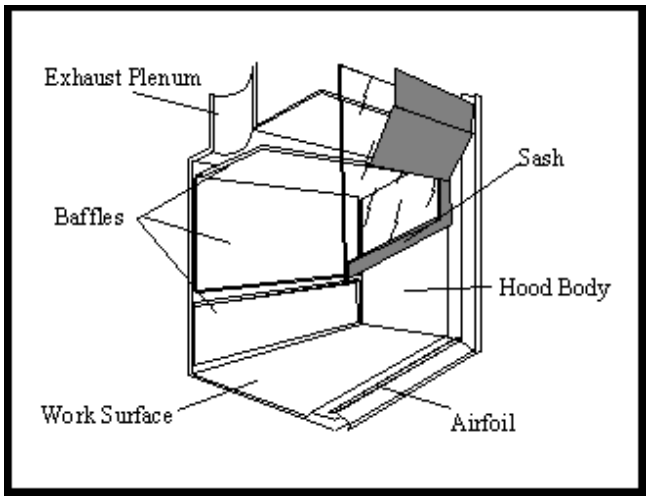
5.3 Perchloric Acid Hood

A perchloric acid hood is a specialized independent hood with a built-in water wash down system. When perchloric acid is heated above ambient temperature, it will vaporize and condense on hood, duct, and fan components. In addition to being highly corrosive, condensed vapors can react with organic materials such as gaskets, greases, and chemical residues to form explosive perchlorate salts and esters. By washing down the hood following each use, materials deposited in the perchloric acid hood are removed, preventing the buildup of shock, heat, and friction sensitive perchlorates.

Perchloric acid will only be heated in the perchloric acid fume hood. The perchloric acid hood is dedicated to perchloric acid use only. Organic materials and those incompatible with perchloric acid will not be used in the perchloric acid hood. The user is responsible for ensuring that the perchloric acid hood is washed down after each use. The hood will be certified on an annual basis along with the rest of the chemical fume hoods.

6.0 New Hoods

New chemical fume hoods will not be purchased and installed without with the approval of the EHS Coordinator in consultation with Building Maintenance Administrators. New hoods will be purchased that meet the design and operation requirements in ANSI Z9.5-1992 and will be tested in accordance with ANSI/ASHRAE 110 before use. New hoods will be added to this program after initial certification.



Hood and vent components

7.0 User Guidelines (Standard Operating Procedures)

1. ***Confirm that hood is operational.*** If hood is equipped with a local on/off switch, make sure switch is in the on position. Check the air flow gauge if so equipped. Check the telltale (a green, one inch by six inch piece of crepe paper attached to the bottom of the sash). The telltale should be noticeably pulled toward the back of the hood.
2. ***Set up work at least six inches from the face opening.*** This will avoid turbulence at the sash edge and provide greater protection.
3. ***Separate and elevate each instrument.*** Use blocks or racks to elevate equipment one to two inches off the hood deck surface so that air can easily flow around all apparatus with no disruption.
4. ***Lower sash to the optimum height.*** The sash will then act as a physical barrier in the event of an unplanned incident in the hood.
5. ***Keep hood storage to an absolute minimum.*** Keep only items needed for ongoing operation inside the hood. Excess materials in the hood disrupt airflow and can act as a barrier or cause airflow to bounce back across the face of the hood. Keep the back bottom slot clear at all times as it serves as an exhaust port for fumes and heat generated near the surface.
6. ***Minimize foot traffic near and around the hood.*** A person walking past the hood can create competing air currents. Other cross drafts should be eliminated such as open doors or fans.
7. ***Use extreme caution with ignition sources inside a fume hood.*** Ignition sources such as electrical connections and equipment, hot plates, controllers, and open flame will ignite flammable vapors or explosive particles from materials being used in the hood. All electrical equipment used inside a fume hood must be designed or certified as intrinsically safe unless it can be absolutely established (and enforced) that flammable or explosive materials will not be used in a particular hood.
8. ***Never put your head inside a hood while operations are in progress.*** The plane of the sash is the imaginary boundary that should not be crossed except to set up or dismantle equipment.
9. ***Clean up spills as soon as possible.***
10. ***Do not dismantle or modify the physical structure of the hood or exhaust system*** in any way without first consulting Building Maintenance personnel at x7131. Any component removed to conduct maintenance, repair, or to set up an experiment must be replaced prior to using the hood.
11. ***Report airflow problems and problems with the physical structure of the hood*** to Building Maintenance as soon as possible.
12. ***Lower the sash completely*** when you are not physically working in the hood.

Laboratory Safety Glossary

ACGIH: ACGIH stands for American Conference of Governmental Industrial Hygienists. The ACGIH is an association of occupational health professionals employed by government and educational institutions. The Threshold Limit Value (**TLV**) Committee and Ventilation Committee of the ACGIH publish guidelines which are used worldwide.

ACTIVE INGREDIENT: An active ingredient is the part of a product which actually does what the product is designed to do. It is not necessarily the largest or most hazardous part of the product. For example, an insecticidal spray may contain less than 1% pyrethrin, the ingredient which actually kills insects. The remaining ingredients are often called inert ingredients.

ACUTE: Acute means sudden or brief. Acute can be used to describe either an exposure or a health effect. An acute exposure is a short-term exposure. Short-term means lasting for minutes, hours or days. An acute health effect is an effect that develops either immediately or a short time after an exposure. Acute health effects may appear minutes, hours or even days after an exposure. (See also Chronic.)

ACUTE EFFECT: Health effects that usually occur rapidly, as a result of short-term exposure.

ACUTE TOXICITY: Acute effects resulting from a single dose of, or exposure to, a substance.

AEROSOL: A collection of very small particles suspended in air. The particles can be liquid (mist) or solid (dust or fume). The term aerosol is also commonly used for a pressurized container (aerosol can) which is designed to release a fine spray of a material such as paint. Inhalation of aerosols is a common route of exposure to many chemicals. Also, aerosols may be fire hazards.

AIHA: AIHA stands for American Industrial Hygiene Association.

ANSI: American National Standards Institute is a privately funded, voluntary membership organization that identifies industrial and public needs for national consensus standards and coordinates development of such standards.

APPEARANCE: A description of a substance (including color, size, and consistency) at normal room temperature and normal atmospheric conditions.

ASPHYXIANT: A gas or vapor which can take up space in the air and reduce the concentration of oxygen available for breathing. Examples include acetylene, methane, and carbon dioxide.

AUTO-IGNITION TEMPERATURE: The temperature at which a material will ignite spontaneously or burn. The auto-ignition temperature is the lowest temperature at which a material begins to burn in air in the absence of a spark or flame. Many chemicals will decompose (break down) when heated. The auto ignition temperature is the temperature at which the chemicals formed by decomposition begin to burn. Auto-ignition temperatures for a specific material can vary by one hundred degrees Celsius or more, depending on

the test method used. Therefore, values listed on the SDS may be rough estimates. To avoid the risk of fire or explosion, materials must be stored and handled at temperatures well below the auto-ignition temperature.

BEST AVAILABLE CONTROL TECHNOLOGY (BACT): The best control technology that is available for each contaminant. This determination will be made by the Commissioner on a case-by-case basis taking into account energy, environmental, health risk, costs and economic impacts of alternative control systems.

BIOHAZARDOUS INFECTIOUS MATERIAL: Under the Canadian Controlled Products Regulations, a biohazardous infectious material is a material that contains organisms which can cause disease in humans or animals. For example, a person exposed to a blood sample from someone with hepatitis B may contract the disease. Some jurisdictions require SDSs for products which contain biohazardous infectious materials.

BOD: BOD stands for biochemical oxygen demand.

BOILING POINT: Temperature at which a liquid changes to a vapor state at a given pressure (usually sea level pressure = 760 mmHg).

The boiling point is the temperature at which the material changes from a liquid to a gas. Below the boiling point, the liquid can evaporate to form a vapor. As the material approaches the boiling point, the change from liquid to vapor is rapid and vapor concentrations in the air can be extremely high.

Airborne gases and vapors may pose fire, explosion and health hazards. Sometimes, the boiling point of a mixture is given as a range of temperatures. This is because the different ingredients in a mixture can boil at different temperatures. If the material decomposes (breaks down) without boiling, the temperature at which it decomposes may be given with the abbreviation "**dec**." Some of the decomposition chemicals may be hazardous. (*See also Thermal Decomposition Products.)*

"C" OR CEILING: The maximum allowable human exposure limit for an airborne substance, not to be exceeded even momentarily. Examples: hydrogen chloride, chlorine, nitrogen dioxide, and some isocyanates have ceiling standards.
1. It has been evaluated by the International Agency for Research on Cancer (**IARC**), and found to be a carcinogen or potential carcinogen; or
2. It is listed as a carcinogen or potential carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (**NTP**); or
3. It is regulated by OSHA as a carcinogen; or
4. There is valid scientific evidence in man or animals demonstrating a cancer-causing potential.

CARCINOGEN, CARCINOGENIC, CARCINOGENICITY: A carcinogen is a substance which can cause cancer. Carcinogenic means able to cause cancer. Carcinogenicity is the ability of a substance to cause cancer. Under the Canadian Controlled Products Regulations, materials are identified as carcinogens if they are recognized as carcinogens by the American Conference of Governmental Industrial Hygienists (ACGIH), or the International Agency for Research on Cancer (IARC). Under the US OSHA Hazard Communication (HazCom) Standard, materials are identified as carcinogens on SDSs if they are listed as either carcinogens or potential carcinogens by IARC or the US National

Toxicology Program (NTP), if they are regulated as carcinogens by OSHA, or if there is valid scientific evidence in man or animals demonstrating a cancer causing potential. The lists of carcinogens published by the IARC, ACGIH and NTP include known human carcinogens and some materials which cause cancer in animal experiments. Certain chemicals may be listed as suspect or possible carcinogens if the evidence is limited or so variable that a definite conclusion cannot be made.

CAS REGISTRY NUMBER: The CAS Registry Number is a number assigned to a material by the Chemical Abstracts Service (**CAS**) of the American Chemical Society (**ACS**). The CAS number provides a single unique identifier. A unique identifier is necessary because the same material can have many different names. For example, the name given to a specific chemical may vary from one language or country to another.

The CAS Registry Number is similar to a telephone number and has no significance in terms of the chemical nature or hazards of the material. The CAS Registry Number can be used to locate additional information on the material, for example, when searching in books or chemical data bases.

CC: Depending on the context, CC can stand for closed cup, cubic centimeters or ceiling concentration.

CCC: CCC stands for Cleveland closed cup, a standard method of determining flash points.

CCOHS: CCOHS stands for the Canadian Centre for Occupational Health and Safety. CCOHS provides an occupational health and safety information service through answers to inquiries, publications and a computerized information service. The computerized information is available both online (CCINFOWeb) and on CD-ROM (CCINFOdisc).

CEILING (C): See Exposure Limits for a general explanation.

CERCLA: CERCLA stands for Comprehensive Environmental Response, Compensation and Liability Act (U.S.).

CHEMICAL FAMILY: The chemical family describes the general nature of the chemical. Chemicals belonging to the same family often share certain physical and chemical properties and toxic effects. However, there may also be important differences. For example, toluene and benzene both belong to the aromatic hydrocarbon family. However, benzene is a carcinogen, but toluene is not.

CHEMICAL FORMULA: The chemical formula, sometimes called the molecular formula, tells which elements (carbon, hydrogen, oxygen, and so on) make up a chemical. It also gives the number of atoms of each element in one unit or molecule of the chemical.

CHEMICAL NAME: The chemical name is a proper scientific name for an ingredient of a product. For example, the chemical name of the herbicide 2,4-D is 2,4-dichlorophenoxyacetic acid. The chemical name can be used to obtain additional information.

CHEMICAL REACTIVITY: Chemical reactivity is the ability of a material to undergo a chemical change. A chemical reaction may occur under conditions such as heating, burning, contact with other chemicals, or exposure to light.

Undesirable effects such as pressure buildup, temperature increase or formation of other hazardous chemicals may result. (See also Dangerously Reactive Material and Reactive Flammable Material.)

CHEMTREC: CHEMTREC stands for the Chemical Transportation Emergency Centre. It is a U.S. national center established by the Chemical Manufacturers Association (**CMA**) to relay pertinent emergency information concerning specific chemicals on requests from individuals. CHEMTREC has a 24-hour toll-free telephone number to help respond to chemical transportation emergencies for companies who have registered with them for this service.

CHRONIC HEALTH EFFECTS: Either adverse health effects resulting from long-term exposure or persistent adverse health effects resulting from short-term exposure.

CHRONIC TOXICITY: Adverse (chronic) effects resulting from repeated doses of or exposures to a substance over a relatively prolonged period of time. Ordinarily used to denote effects in experimental animals.

CHRONIC: Chronic means long-term or prolonged. It can describe either an exposure or a health effect. A chronic exposure is a long-term exposure. Long-term means lasting for months or years. A chronic health effect is an adverse health effect resulting from long-term exposure or a persistent adverse health effect resulting from a short-term exposure. The Canadian Controlled Products Regulations describe technical criteria for identifying materials which cause chronic health effects. (See also Acute.)

CNS: CNS stands for central nervous system.

COC: COC stands for Cleveland open cup, a standard method of determining flash points.

COD: COD stands for chemical oxygen demand.

COEFFICIENT OF OIL/WATER DISTRIBUTION: The coefficient of oil/water distribution, also called the partition coefficient (abbreviated as **P**), is the ratio of the solubility of a chemical in an oil to its solubility in water.

The **P** value is typically presented as a logarithm of P (**log P**). It indicates how easily a chemical can be absorbed into or stored in the body. The P value is also used to help determine the effects of the chemical on the environment.

COMBUSTIBLE LIQUID: Any liquid having a flash point at or above 100 °F (37.8 °C), but below 200 °F (93.3 °C), except any mixture having components with flash points of 200 °F (93.3 °C) or higher, the total volume of which make up 99 per cent or more of the total volume of the mixture.

COMBUSTIBLE LIQUID: Under the Canadian Controlled Products Regulations, a combustible liquid has a flash point from 37.8 to 93.3 degrees C (100 to 200 degrees F) using a closed cup test. The US OSHA HazCom Standard uses a similar definition. This range of flash points is well above normal room temperature. Combustible liquids are, therefore, less of a fire hazard than flammable liquids. If there is a possibility that a combustible liquid will be heated to a temperature near its flash point, appropriate precautions must be taken to prevent a fire or explosion.

COMBUSTIBLE: Combustible means able to burn. Broadly speaking, a material is combustible if it can catch fire and burn. However, in many jurisdictions, the term combustible is given a specific regulatory meaning. (***See Combustible Liquid***.) The terms combustible and flammable both describe the ability of a material to burn. Commonly, combustible materials are less easily ignited than flammable materials.

COMMON NAME: Any designation or identification such as code name, code number, trade name, brand name, or generic name used to identify a chemical other than by its chemical name.

COMPRESSED GAS: A compressed gas is a material which is a gas at normal room temperature and pressure but is packaged as a pressurized gas, pressurized liquid or refrigerated liquid. The Canadian Controlled Products Regulations and the U.S. HazCom standard describe technical criteria for identifying materials which are classified as compressed gases. Regardless of whether a compressed gas is packaged in an aerosol can, a pressurized cylinder or a refrigerated container, it must be stored and handled very carefully. Puncturing or damaging the container or allowing the container to become hot may result in an explosion.

CONDITIONS TO AVOID: Conditions encountered during handling or storage that could cause a substance to become unstable.

CONFIRMED HUMAN CARCINOGEN: Substances recognized to have carcinogenic or cocarcinogenic potential in humans.

CORROSIVE MATERIAL: A corrosive material can attack (corrode) metals or human tissues such as the skin or eyes. Corrosive materials may cause metal containers or structural materials to become weak and eventually to leak or collapse.

Corrosive materials can burn or destroy human tissues on contact and can cause effects such as permanent scarring or blindness. The Canadian Controlled Products Regulations and the US OSHA HazCom Standard, specify technical criteria for identifying materials which are classified as corrosive materials for the purposes of each regulation. (***See also pH***.)

CORROSIVE MATERIAL: A liquid or solid that causes visible destruction or irreversible alteration in human skin tissue at the site of contact.

CU M or CU.M: This stands for cubic meter

DANGEROUSLY REACTIVE MATERIAL: The Canadian Controlled Products Regulations describes technical criteria for identifying materials which are classified as dangerously reactive. A dangerously reactive material can react vigorously:
- with water to produce a very toxic gas;
- on its own by polymerization or decomposition; or
- under conditions of shock, or an increase in pressure or temperature.

ANSI defines a dangerously reactive material as one that is able to undergo a violent self-accelerating exothermic chemical reaction with common materials, or by itself. A dangerously reactive material may cause a fire, explosion or other hazardous condition. It is very important to know which conditions (such as shock, heating or contact with water) may set off the dangerous reaction so that appropriate preventive measures can be taken.
See also the U.S. OSHA HAZCOM definitions for unstable (reactive) and water reactive.

DECOMPOSITION PRODUCTS: Describes hazardous materials produced during heated operations.

DECOMPOSITION: Breakdown of a material or substance (by heat, chemical reaction, electrolysis, decay, or other processes) into simpler compounds.

DENSITY: The mass of a substance per unit volume. The density of a substance is usually compared to water, which has a density of 1. Substances which float on water have densities less than 1; substances which sink have densities greater than 1.

DENSITY: The density of a material is its weight for a given volume. Density is usually given in units of grams per milliliter (g/mL) or grams per cubic centimeter (g/cc). Density is closely related to specific gravity (relative density). The volume of a material in a container can be calculated from its density and weight.

DERMAL TOXICITY: Adverse effects resulting from skin exposure to a substance.

DERMAL: Used on, or applied to, the skin.

DILUTION VENTILATION: See General Ventilation.

DOT: DOT stands for the U.S. Department of Transportation.

DRY CHEMICAL: A powdered, fire-extinguishing agent usually composed of sodium bicarbonate, potassium bicarbonate, etc.

EHS: Environmental Health and Safety Office.

EMBRYO: An embryo is an organism in the early stages of its development prior to birth. In humans, the embryo is the developing child from conception to the end of the second month of pregnancy. (See also Fetus/Foetus.)

EMBRYOTOXIC, EMBRYOTOXICITY: Embryotoxic means harmful to the embryo. Embryotoxicity is the ability of a substance to cause harm to the embryo. The Canadian Controlled Products Regulations describe technical criteria for identifying materials which have teratogenicity and embryotoxicity.

ENGINEERING CONTROLS: Engineering controls help reduce exposure to potential hazards either by isolating the hazard or by removing it from the work environment. Engineering controls include mechanical ventilation and process enclosure. They are important because they are built into the work process. Engineering controls are usually preferred to other control measures such as the use of personal protective equipment. Substitution of a less hazardous material or industrial process is the best way to reduce a hazard and is often considered to be a type of engineering control.

EPA: EPA stands for the U.S. Environmental Protection Agency.

EU: EU stands for the European Union, formerly known as the EEC (European Economic Community) and the EC (European Community).

EXPLOSION LIMITS: The range of concentration of a flammable gas or vapor (% by volume in air) in which explosion can occur upon ignition in a confined area. The boundary-line mixtures of vapor or gas with air, which, if ignited, will just propagate the flame.

EXPLOSIVE: A chemical that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

EXPOSURE: A person's contact with a hazardous chemical in the course of employment through any route of entry (inhalation, ingestion, skin contact or absorption, etc.).

EXTINGUISHING MEDIA: Specifies the fire-fighting agents that should be used to extinguish fires.

FLAMMABLE: A chemical that includes one of the following categories: 1. Liquid, flammable--Any liquid having a flash point below 100 °F (37.8 °C), except any mixture having components with flash points of 100 °F (37.8 °C) or higher, the total of which make up 99 percent or more of the total mixture volume. 2. Solid, flammable--A solid, other than an explosive, that can cause fire through friction, absorption of mixture, spontaneous chemical change, or retained heat from manufacturing or processing, or that can be readily ignited and, when ignited, will continue to burn or be consumed after removal from the source of ignition.

FLASH POINT: The temperature at which a liquid will give off enough flammable vapor to ignite. The lower the flash point, the more dangerous the product. A **"flammable liquid"** is a solution with a flash point below 100 °F (37.8 °C). Flash point values are most important when dealing with hydrocarbon solvents. The flash point of a material may vary depending on the method used, so the test method is indicated when the flash point is given.

FORESEEABLE EMERGENCY: Any potential occurrence such as, but not limited to, equipment failure, rupture of containers, or failure of control equipment, which could result in an uncontrolled release of hazardous chemical into the testing environment.

HAZARD RATINGS: Material ratings of one to four which indicate the severity of hazard with respect to health, flammability, and reactivity.

HAZARD WARNING: Any words, pictures, symbols, or combination thereof appearing on a label or other appropriate form of warning which conveys the hazards of the chemical(s) in the container(s).

HAZARDOUS MATERIAL: In a broad sense, any substance or mixture of substances having properties capable of producing adverse effects on the health or safety of a human being.

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

The term "**health hazard**" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatoxins, nephrotoxins, neurotoxins, agents that can act on the hematopoietic system, and agents which damage the lungs, skin, eyes, or mucous membranes.

INCOMPATIBLE: Materials that could cause dangerous reactions from direct contact with one another. These types of chemicals should never be stored together.

INGESTION: The taking in of a substance through the mouth.

INHALATION: The breathing in of a substance in the form of a gas, vapor, fume, mist, or dust.

IRRITANT: A substance which, by contact in sufficient concentration for a sufficient period of time, will cause an inflammatory response or reaction of the eye, skin, or respiratory system. The contact may be a single exposure or multiple exposures.

LEL or LFL: Lower explosive limit, or lower flammable limit, of a vapor or gas; the lowest concentration (lowest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present. At concentrations lower than the LEL, the mixture is too "**lean**" to burn. See UEL.

LETHAL CONCENTRATION 50 (LC50)**:** The concentration of a material in air which, on the basis of laboratory tests, is expected to kill 50 percent of a group of test animals when administered as a single exposure (usually 1 to 4 hours).

LETHAL DOSE 50 (LD50): A single dose of a material expected to kill 50 percent of a group of test animals. The dose is expressed as the amount per unit of body weight, the most common expression being milligrams of material per kilogram of body weight (mg/kg of body weight). Usually refers to oral or skin exposure.

MAXIMUM ACCEPTABLE AMBIENT CONCENTRATION (MAAC): The maximum allowable twenty-four hour average concentration, in ambient air, of a toxic air contaminant.

MEDIAN LETHAL CONCENTRATION (LC50): The atmospheric concentration found to be lethal to 50 percent of a group of test animals exposed for the specified time period.

MEDIAN LETHAL DOSE (LD50): The dose found to be lethal in 50 percent of a group of test animals when administered by the specified route, e.g., oral or dermal.

MELTING POINT: The temperature at which a solid substance changes to a liquid state. For mixtures, the melting range may be given.

MIXTURE: Any combination of two or more chemicals if the combination is not, in whole or in part, the result of a chemical reaction.

MUTAGEN: Those chemicals or physical effects that can alter genetic material in an organism and result in physical or functional changes in all subsequent generations.

NFPA: National Fire Protection Association is an international membership organization which promotes/improves fire protection and prevention and establishes safeguards against loss of life and property by fire. Best known on the industrial scene for the National Fire Codes (16 volumes of codes, standards, recommended practices and manuals developed and periodically updated by NFPA technical committees).

Among these is NFPA 704M, the code for showing hazards of materials as they might be encountered under fire or related emergency conditions, using the familiar diamond-shaped labels or placards with appropriate numbers and symbols.

NTP: National Toxicology Program. The NTP publishes an Annual Report on Carcinogens which identifies substances that have been studied and found to be carcinogens in animal or human evaluations.

OCCUPATIONAL EXPOSURE LIMIT (OEL): The most restrictive eight-hour time weighted average concentration specified for workroom air selected from either the 1986-1987 Threshold Limit Values and Biological Exposure Indices as adopted by the American Conference of Governmental Industrial Hygienists; the Recommended Standards for Occupational Exposure set forth in the July 1985 summary of National Institute for Occupational Safety and Health Recommendations for Occupational Health Standards; or the 1986 Workplace Environmental Exposure Levels set forth by the American Industrial Hygiene Association.

ORAL TOXICITY: Adverse effects resulting from taking a substance into the body via the mouth. Ordinarily used to denote effects in experimental animals.

OSHA: Occupational Safety and Health Administration, U.S. Department of Labor, the agency that regulates workplace conditions.

OXIDIZER: A chemical other than a blasting agent or explosive that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.

PERMISSIBLE EXPOSURE LIMITS (**PEL's**)**:** PEL's are OSHA's legal exposure limits.
pH of 7 is neutral. Numbers from 7 to 14 indicate greater alkalinity. Numbers from 7 to 0 indicate greater acidity.

pH: A symbol relating the hydrogen ion (**H+**) concentration of a given standard solution.

PHYSICAL HAZARD: A chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water-reactive.

POLYMERIZATION: A chemical reaction in which one or more small molecules combine to form larger molecules at a rate that releases large amounts of energy. If hazardous polymerization can occur with a given material, the MSDS will usually list conditions which could start the reaction. In most cases the material contains a polymerization inhibitor, which if used up, is no longer capable of preventing a reaction.

PPB (Parts Per Billion): Parts of vapor or gas per billion parts of contaminated air by volume.

PPM (Parts Per Million): Parts of vapor or gas per million parts of contaminated air by volume.

RCRA: Resource Conservation and Recovery Act, administered by the EPA.

REACTIVITY: A description of the tendency of a substance to undergo chemical reaction with the release of energy. Undesirable effects such as pressure build-up, temperature increase, and formation of noxious, toxic or corrosive byproducts may occur because of the reactivity of a substance by heating, burning, direct contact with other materials, or other conditions in use or in storage.

SARA Title III: Title III of the Superfund Amendments and Reauthorization Act of 1986, also known as the Emergency Planning and Community Right-To-Know Act. It requires extensive submission of information about hazardous chemicals to the EPA, states, and local communities, and establishes a national program of emergency planning. Administered by the EPA.

SENSITIZER: A substance which on first exposure causes little or no reaction, but which on repeated exposure may cause a marked response not necessarily limited to the contact site. Skin sensitization is the most common form of sensitization in the industrial setting, although respiratory sensitization to a few chemicals is also known to occur.

SHIPPING INFORMATION: The appropriate name(s), hazard class(es), and identification number(s) as determined by the United States Department of Transportation, International Regulations, and the International Civil Aviation Organization.

SPECIFIC GRAVITY: The weight of a material compared to the weight of an equal volume of water is an expression of the density (or heaviness) of a material. Insoluble materials with specific gravity of less than 1.0 will float in or on water.

Insoluble materials with specific gravity greater than 1.0 will sink in water. Most (but not all) flammable liquids have specific gravity less than 1.0 and, if not soluble, will float on water an important consideration for fire suppression.

SUBSTANCES OF HIGH TOXICITY: Those chemicals having an acute toxicity of either (1) Median Lethal Dose, single oral dose, rat, less than or equal to 50 mg/kg, or (2) Median Lethal Concentration, four-hour inhalation exposure, rat, less than or equal to 100 ppm, or (3) Median Lethal Dose, dermal exposure, rabbits, less than or equal to 100 mg/kg.

SUBSTANCES OF LOW TOXICITY: Those substances that have been shown to produce low toxicity or irritation, or those chemicals having an acute toxicity of either (1) Median Lethal Dose, single oral dose, rat, greater than 500 mg/kg but less than 5 g/kg, or (2) Median Lethal Concentration, four-hour inhalation exposure, rat, greater than 1,000 ppm but less than 10,000 ppm, or (3) Median Lethal Dose, dermal exposure, rabbits, greater than 500 mg/kg but less than 3,000 mg/kg.

SUBSTANCES OF MODERATE TOXICITY: Those substances that have been shown to produce moderate toxicity following exposure or have been demonstrated to produce carcinogenic, mutagenic, or teratogenic action in a single animal species with little or no human evidence of carcinogenic, mutagenic, or teratogenic action, or those chemicals having an acute toxicity of either (1) Median Lethal Dose, single oral dose, rat, greater than 50 mg/kg but less than 500 mg/kg, or (2) Median Lethal Concentration, four-hour inhalation exposure, rat, greater than 100 ppm but less than 1,000 ppm, or (3) Median Lethal Dose, dermal exposure, rabbits, greater than 100 mg/kg but less than 500 mg/kg.

SUSPECT HUMAN CARCINOGEN: A substance suspected of inducing cancer based on human evidence or demonstration by appropriate methods, or carcinogenesis in two or more animal species or strains.

TERATOGEN: Any substance that causes growth abnormalities in embryos, and/or genetic modifications in cells, etc.

THRESHOLD LIMIT VALUE (TLV): Airborne concentration of substances established by the American Conference of Governmental Industrial Hygienists, which represent conditions under which it is believed that nearly all workers may be repeatedly exposed day after day without adverse effect.

THRESHOLD LIMIT VALUES (TLV's): Expresses the airborne concentration of a material to which nearly all persons can be exposed, day after day, without adverse effects. TLV's are expressed three ways:
1. TLV-TWA: The allowable Time Weighted Average concentration for a normal 8-hour workday (40-hour work week).
2. TLV-STEL: The short-term exposure limit or maximum concentration for a continuous 15-minute exposure period (maximum of four such periods per day, with at least 60 minutes between exposure periods) and provided the TLV-TWA is not exceeded.
3. TLV-C: The ceiling exposure limit is the concentration that should never be exceeded, even instantaneously.

TOXIC: Refers to a chemical falling within any of the following toxic categories:
1. A chemical that has a median lethal dose (LD50) of more than 50 milligrams per kilogram, but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 milligrams each.
2. A chemical that has a median lethal dose (LD50) of more than 200 milligrams per kilogram, but not more than 1000 milligrams per kilogram of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between 2 and 3 kilograms each.
3. A chemical that has a median lethal concentration (LC50) in air of more than 200 parts per million, but not more than 2000 parts per million by volume of gas or vapor, or more than two milligrams per liter, but not more than 20 milligrams per liter of mist, fume or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

TOXICITY: The sum of adverse effects resulting from exposure to a material, generally by the mouth, skin, or respiratory tract.

TWA (Time Weighted Average exposure): The airborne concentration of a material to which a person is exposed, averaged over the total exposure time, generally the total workday (8 to 12 hours).

UEL or UFL: Upper explosive limit or upper flammable limit of a vapor or gas; the highest concentration (highest percentage of the substance in air) that will produce a flash of fire when an ignition source (heat, arc, or flame) is present. At higher concentrations, the mixture is too "**rich**" to burn. See LEL.

UNSTABLE: Tending toward decomposition or another state, or as produced or transported, will vigorously polymerize, decompose, condense, or become self-reactive under condition of shocks, pressure, or temperature.

VAPOR DENSITY: The density of a material's vapor compared to the density of the air. If a vapor density is greater than one, it is more dense than air and will drop to the floor or the lowest point available. If the density is less than one, it is lighter than air and will float upwards like helium.

VAPOR PRESSURE: The pressure exerted at a given temperature of a vapor in equilibrium with its liquid or solid form. The higher the vapor pressure, the more easily a liquid will evaporate. Liquid materials that evaporate easily are termed volatile, and this means that air concentrations can build up quickly when working with the material in liquid form.

Common SDS Definitions

Health Hazards

acute: resulting from a single exposure to a toxic or hazardous chemical.

allergen: a substance capable of causing an allergic response. An allergic response is an abnormal response of a hypersensitive person to chemical and physical stimuli.

biohazardous: describes an agent that is biological in nature and capable of self-replication and that has the capacity to produce deleterious effects on other biological organisms, particularly humans.

carcinogenic: describes a material capable of producing cancer in test animals and/or humans.

chronic: resulting from repeated exposure to sub-lethal doses of toxic or hazardous chemicals over a period of time.

cytotoxic: describes chemicals toxic to cells because of DNA disruption.

hazardous chemical: any chemical that is a physical or health hazard. The degree of hazard is generally based upon the extent of exposure or usage.

irritant: a non-corrosive material that causes a reversible inflammatory effect on living tissue by chemical action at the site of contact as a function of concentration or duration of exposure.

mutagenic: capable of producing genetic changes in animals and/or humans that are passed on to future generations of offspring.

reproductive toxin: any agent that has a harmful effect on the adult male or female reproductive system or a developing fetus or child. Such hazards have a variety of effects on people, including loss of sexual drive, mental disorders, impotence, infertility, sterility, mutagenic effects on germ cells, teratogenic effects on a fetus, and transplacental carcinogenesis.

sensitizer: a material that on first exposure causes little or no reaction in humans or test animals but that after repeated exposure may cause a marked response not necessarily limited to the contact site. Skin sensitization is the most common form. Respiratory sensitization to a few chemicals is also known to occur.

target organ effect: effects on specifically listed organs and systems, such as the liver, kidneys, nervous system, lungs, skin, and eyes, caused by exposure to a material.

teratogenic: describes a material capable of producing birth defects in animals and humans.

toxicity: the ability of a chemical to do harm to the human organism.

Physical Hazards

asphyxiant: a vapor or gas that can cause unconsciousness or death due to lack of oxygen. Most simple asphyxiants are harmful to the body only when they become so concentrated that they reduce the available oxygen to 18 percent of air.

boiling point: temperature at which a liquid boils or changes to a vapor.

combustible liquid: combustible liquids have a flash point of 100°F (38°C) or higher. Non-liquid materials, such as wood or paper, are classified as ordinary combustibles.

corrosive: a chemical that causes visible destruction of or irreversible alterations in living tissue by chemical action at the site of contact; a liquid that causes a severe corrosion rate in steel.

explosive: a chemical that causes sudden or instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

flammable liquid: defined as a liquid with a flash point below 100°F (38°C), a liquid that gives off vapors readily ignitable at room temperature.

oxidizer: a substance that yields oxygen readily to stimulate the combustion of other materials.

polymerization: a condition that occurs when a substance reacts with itself and releases heat that can lead to an explosion.

pyrophoric: capable of spontaneous ignition when exposed to air at temperatures of 130°F or below.

radioactive material: material that emits energy as alpha, beta, or gamma radiation from the nucleus of an atom. Always involves changes of one kind of atom into a different kind.

reactive material: a chemical substance or mixture that vigorously polymerizes, decomposes, condenses, or becomes self-reactive due to shock, pressure, or temperature. Includes materials or mixtures that fall within any of these categories: (1) organic peroxide, (2) pressure-generating material, and (3) water reactive material.

specific gravity: a mass-to-volume comparison relative to water (1). A specific gravity below 1 will float in water, above 1 will sink.

unstable reactive: a chemical that in its pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or become self-reactive under conditions of shock, pressure, or temperature.

vapor density: compares a chemical's vapor density to air density (1). A vapor below 1 will rise in air, above 1 will sink.

vapor pressure: the higher the number, the faster a chemical evaporates, increasing inhalation risk.

water reactive agent: a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

Hazardous Limits

flash point: the lowest temperature at which a liquid gives off enough vapors to allow ignition

lower explosive limit (LEL): the lowest end of the range at which the gas or vapor level is sufficient to burn or explode if exposed to an ignition source. Below that level the mixture is too lean to burn.

permissible exposure limit (PEL): the averaged maximum concentration of a chemical in the air that a person can be exposed to repeatedly without developing health problems. Generally expressed in parts per million (ppm). Concentrations at or above the PEL make respiratory protection mandatory.

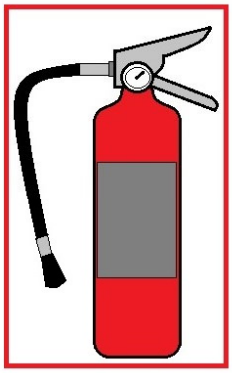
threshold limit value (TLV): the quantity of chemical exposure that an individual can tolerate on a daily or routine basis during his or her working life without incurring adverse effects from the exposure.

upper explosive limit (UEL): the upper end of the range at which the gas or vapor level is sufficient to burn or explode if exposed to an ignition source. Above that level the mixture is too rich to burn.

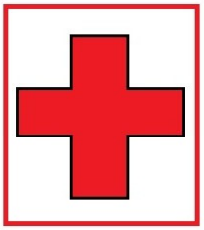
EMERGENCY SHOWER LOCATION:

EMERGENCY EYEWASH LOCATION:

FIRE EXTINGUISHER LOCATION:

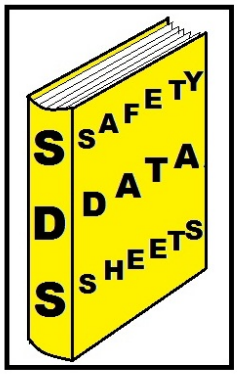


FIRST-AID LOCATION



CHEMICAL SPILL KIT LOCATION:

SAFETY DATA SHEET AND TRAINING INFO LOCATION:



SAFETY INFORMATION

States with Approved Plans

Commissioner
Alaska Department of Labor
1111 West 8th Street Room 306
Juneau, AK 99801
(907) 465-2700

Director
Industrial Commission of Arizona
800 W. Washington
Phoenix, AZ 85007
(602) 542-5795

Director
California Department of Industrial Relations
45 Fremont Street
San Francisco, CA 94105
(415) 972-8835

Commissioner
Connecticut Department of Labor
200 Folly Brook Boulevard
Wethersfield, CT 06109
(860) 566-5123

Director
Hawaii Department of Labor and Industrial Relations
830 Punchbowl Street
Honolulu, HI 96813
(808) 586-8844

Commissioner
Indiana Department of Labor
State Office Building
402 West Washington Street Room W195
Indianapolis, IN 46204
(317) 232-2378

Commissioner
Iowa Division of Labor Services
1000 E. Grand Avenue
Des Moines, IA 50319
(515) 281-3447

Secretary
Kentucky Labor Cabinet
1047 U.S. Highway, 127 South Suite 2
Frankfort, KY 40601
(502) 564-3070

Commissioner
Maryland Division of Labor and Industry
Department of Labor Licensing and Regulation
1100 N. Eutaw Street, Room 613
Baltimore, MD 21202-2206
(410) 767-2999

Director
Michigan Department of Consumer and Industry Services
4th Floor, Law Building
P.O. Box 30004
Lansing, MI 48909
(517) 373-7230
Commissioner

Minnesota Department of Labor and Industry
443 Lafayette Road
St. Paul, MN 55155
(612) 296-2342

Director
Nevada Division of Industrial Relations
400 West King Street
Carson City, NV 89710
(702) 687-3032

Secretary
New Mexico Environment Department
1190 St. Francis Drive
P.O. Box 26110
Santa Fe, NM 87502
(505) 827-2850

Commissioner
New York Department of Labor
W. Averell Harriman State Office Building -12 Room 500 Albany, NY 12240 (518) 457-2741

Commissioner
North Carolina Department of Labor
319 Chapanoke Road
Raleigh, NC 27603
(919) 662-4585

Administrator
Department of Consumer and Business Services
Occupational Safety and Health Division (OR-OSHA)
350 Winter Street, N.E. Room 430
Salem, OR 97310
(503) 378-3272

Secretary
Puerto Rico Department of Labor and Human Resources
Prudencio Rivera Martinez Building
505 Munoz Rivera Avenue
Hato Rey, PR 00918
(809) 754-2119

Commissioner
South Carolina Department of Labor, Licensing, and Regulation
110 Centerview Drive
P.O. Box 11329
Columbia, SC 29211-1329
(803) 734-9594

Commissioner
Tennessee Department of Labor
Attention: Robert Taylor
710 James Robertson Parkway
Nashville, TN 37243-0659
(615) 741-2582

Commissioner
Industrial Commission of Utah
160 East 300 South, 3rd Floor
P.O. Box 146600
Salt Lake City, UT 84114-6600
(801) 530-6898

Commissioner
Vermont Department of Labor and Industry
National Life Building - Drawer 20
120 State Street
Montpelier, VT 05620
(802) 828-2288

Commissioner
Virgin Islands Department of Labor
2131 Hospital Street Box 890
Christiansted
St. Croix, VI 00820-4666
(809) 773-1994

Commissioner
Virginia Department of Labor and Industry
Powers-Taylor Building
13 South 13th Street
Richmond, VA 23219
(804) 786-2377

Director
Washington Department of Labor and Industries
General Administration Building
P.O. Box 44001
Olympia, WA 98504-4001
(360) 902-4200

Administrator
Workers' Safety and Compensation Division (WSC)
Wyoming Department of Employment
Herschler Building 2nd Floor East
122 West 25th Street
Cheyenne, WY 82002
(307) 777-7786

OSHA Consultation Project Directory

Alabama
(205) 348-7136

Alaska
(907) 269-4957

Arizona
(602) 542-5795

Arkansas
(501) 682-4532

California
(415) 972-8515

Colorado
(970) 491-6151

Connecticut
(860) 566-4550

Delaware
(302) 761-8219

District of Columbia
(202) 576-6339

Florida
(904) 488-3044

Georgia
(404) 894-2646

Guam
(671) 475-0136

Hawaii
(808) 568-9100

Idaho
(208) 385-3283

Illinois
(312) 814-2337

Indiana
(317) 232-2688

Iowa
(515) 965-7162

Kansas
(913) 296-7476

Kentucky
(502) 564-6895

Louisiana
(504) 342-9601

Maine
(207) 624-6460

Maryland
(410) 880-4970

Massachusetts
(617) 727-3982

Michigan
(517) 332-1817(H)
(517) 322-1809(S)

Minnesota
(612) 297-2393

Mississippi
(601) 987-3981

Missouri
(573) 751-3403

Montana
(406) 444-6418

Nebraska
(402) 471-4717

Nevada
(702) 486-5016

New Hampshire
(603) 271-2024

New Jersey
(609) 292-2424

New Mexico
(505) 827-4230

New York
(518) 457-2481

North Carolina
(919) 662-4644

North Dakota
(701) 328-5188

Ohio
(614) 644-2246

Oklahoma
(405) 528-1500

Oregon
(503) 378-3272

Pennsylvania
(412) 357-2561

Puerto Rico
(787) 754-2188

Rhode Island
(401) 277-2438

South Carolina
(803) 734-9614

South Dakota
(605) 688-4101

Tennessee
(615) 741-7036

Texas
(512) 440-3809

Utah
(801) 530-7606

Vermont
(802) 828-2765

Virginia
(804) 786-6359

Virgin Islands
(809) 772-1315

Washington
(360) 902-5638

West Virginia
(304) 558-7890

Wisconsin
(608) 266-8579(H)
(414) 521-5063(S)

Wyoming
(307) 777-3546
(H) - Health
(S) - Safety

OSHA Area Office Telephone Numbers

Albany, NY
(518) 464-4338

Albuquerque, NM
(505) 248-5302

Allentown, PA
(610) 776-0592

Anchorage, AK
(907) 271-5152

Appleton, WI
(414) 734-4521

Austin, TX
(512) 916-5783

Avenel, NJ
(908) 750-3270

Baltimore, MD
(410) 962-2840

Bangor, ME
(207) 941-8177

Baton Rouge, LA
(504) 389-0474

Bayside, NY
(718) 279-9060

Bellevue, WA
(206) 553-7520

Billings, MT
(406) 247-7494

Birmingham, AL
(205) 731-1534

Bismarck, ND
(701) 250-4521

Boise, ID
(208) 334-1867

Bowmansville, NY
(716) 684-3891

Braintree, MA
(617) 565-6924

Bridgeport, CT
(203) 579-5581

Calumet City, IL
(708) 891-3800

Carson City, NV
(702) 885-6963

Charleston, WV
(304) 347-5937

Cincinnati, OH
(513) 841-4132

Cleveland, OH
(216) 522-3818

Columbia, SC
(803) 765-5904

Columbus, OH
(614) 469-5582

Concord, NH
(603) 225-1629

Corpus Christi, TX
(512) 888-3420

Dallas, TX
(214) 320-2400

Denver, CO
(303) 844-5285

Des Plaines, IL
(847) 803-4800

Des Moines, IA
(515) 284-4794

Englewood, CO
(303) 843-4500

Erie, PA
(814) 833-5758

Fort Lauderdale, FL
(305) 424-0242

Fort Worth, TX
(817) 428-2470

Frankfort, KY
(502) 227-7024

Harrisburg, PA
(717) 782-3902

Hartford, CT
(860) 240-3152

Hasbrouck Heights, NJ
(201) 288-1700

Guaynabo, PA
(787) 277-1560

Honolulu, HI
(808) 541-2685

Houston, TX
(281) 286-0583

Houston, TX
(281) 591-2438

Indianapolis, IN
(317) 226-7290

Jackson, MS
(601) 965-4606

Jacksonville, FL
(904) 232-2895

Kansas City, MO
(816) 483-9531

Lansing, MI
(517) 377-1892

Little Rock, AR
(501) 324-6291

Lubbock, TX
(806) 472-7681

Madison, WI
(608) 264-5388

Marlton, NJ
(609) 757-5181

Methuen, MA
(617) 565-8110

Milwaukee, WI
(414) 297-3315

Minneapolis, MN
(612) 664-4560

Mobile, AL
(334) 441-6131

Nashville, TN
(615) 781-5423

New York, NY
(212) 466-2482

Norfolk, VA
(804) 441-3820

North Aurora, IL
(630) 896-8700

Oklahoma City, OK
(405) 231-5351

Omaha, NE
(402) 221-3182

Parsippany, NJ
(201) 263-1003

Peoria, IL
(309) 671-7033

Philadelphia, PA
(215) 597-4955

Phoenix, AZ
(602) 640-2007

Pittsburgh, PA
(412) 644-2903

Portland, OR
(503) 326-2251

Providence, RI
(401) 528-4669

Raleigh, NC
(919) 856-4770

Salt Lake City, UT
(801) 524-5080

Sacramento, CA
(916) 566-7470

San Diego, CA
(619) 557-2909

Savannah, GA
(912) 652-4393

Smyrna, GA
(404) 984-8700

Springfield, MA
(413) 785-0123

St. Louis, MO
(314) 425-4249

Syracuse, NY
(315) 451-0808

Tampa, FL
(813) 626-1177

Tarrytown, NY
(914) 524-7510

Toledo, OH
(419) 259-7542

Tucker, GA
(770) 493-6644

Westbury, NY
(516) 334-3344

Wichita, KS
(316) 269-6644

Wilkes-Barre, PA
(717) 826-6538

Wilmington, DE
(302) 573-6115

OSHA Regional Offices

Region I
(CT,* MA, ME, NH, RI, VT*)
JFK Federal Building Room E-340
Boston, MA 02203
Telephone: (617) 565-9860

Region II
(NJ, NY,* PR,* VI*)
201 Varick Street Room 670
New York, NY 10014
Telephone: (212) 337-2378

Region III
(DC, DE, MD,* PA, VA,* WV)
Gateway Building, Suite 2100
3535 Market Street
Philadelphia, PA 19104
Telephone: (215) 596-1201

Region IV
(AL, FL, GA, KY,* MS, NC, SC,* TN*)
Atlanta Federal Center
61 Forsyth Street, S. W., Room 6T50
Atlanta, GA 30303
Telephone: (404) 562-2300

Region V
(IL, IN,* MI,* MN,* OH, WI)
230 South Dearborn Street Room 3244
Chicago, IL 60604
Telephone: (312) 353-2220

Region VI
(AR, LA, NM,* OK, TX)
525 Griffin Street Room 602
Dallas, TX 75202
Telephone: (214) 767-4731

Region VII
(IA,* KS, MO, NE)
City Center Square
1100 Main Street, Suite 800
Kansas City, MO 64105
Telephone: (816) 426-5861

Region VIII
(CO, MT, ND, SD, UT,* WY*)
1999 Broadway, Suite 1690
Denver, CO 80202-5716
Telephone: (303) 844-1600

Region IX
(American Samoa, AZ,* CA,* Guam, HI,* NV,* Trust Territories of the Pacific)
71 Stevenson Street Room 420
San Francisco, CA 94105
Telephone: (415) 975-4310

Region X
(AK,* ID, OR,* WA*)
1111 Third Avenue, Suite 715
Seattle, WA 98101-3212
Telephone: (206) 553-5930

Footnote(1) U.S. Environmental Protection Agency, Office of Solid Waste and Emergency Response, The Hazardous Waste System (Washington, DC, 1995), p. ES-2.
Footnote(2) If the employee has not had an examination within the last 6 months. Footnote(3) Emergency response to the release of hazardous substances beyond cleanup and TSD sites must also have plans that include these elements and other specific requirements as indicated in 1910.120 (q).
Footnote(4) A physical barricade, natural or man-made, that has been designed and constructed of sufficient thickness and density to withstand or deflect the impact loads of an adjacent explosion.
Footnote(5) A designated work area within the worksite.
Footnote(*) These states and territories operate their own OSHA-approved job safety and health programs (Connecticut and New York plans cover public employees only). States with approved programs must have a standard that is identical to, or at least as effective as, the federal standard.

Emergency Response

Emergency response or responding to emergencies means a response effort by employees from outside the immediate release area or by other designated responders (i.e., mutual aid groups, local fire departments, etc.) to an occurrence which results, or is likely to result, in an uncontrolled release of a hazardous substance.

Responses to incidental releases of hazardous substances where the substance can be absorbed, neutralized, or otherwise controlled at the time of release by employees in the immediate release area, or by maintenance personnel are not considered to be emergency responses within the scope of this standard. Responses to releases of hazardous substances where there is no potential safety or health hazard (i.e., fire, explosion, or chemical exposure) are not considered to be emergency responses.

RCRA Glossary

The terms below are defined as they pertain to the Resource Conservation and Recovery Act.

Abandoned For purposes of defining a material as a solid waste under RCRA Subtitle C, a material that is disposed of, burned, or incinerated.

Accumulated Speculatively Storage of a material in lieu of expeditious recycling. Materials are usually accumulated speculatively if the waste being stored has no viable market or if a facility cannot demonstrate that at least 75 percent of the material has been recycled in a calendar year.

Acknowledgment of Consent Notice sent by the EPA to an exporter of hazardous waste, indicating that the importing country has agreed to accept such waste.

Action Levels For purposes of Subtitle C corrective action, risk-based concentrations of hazardous constituents in ground water, soil, or sediment that may trigger further investigation into possible contamination at a particular site.

Administrative Action Enforcement action taken by the EPA or a state under its own authority, without involving a judicial court process.

Administrative Procedures Act The Act that establishes rulemaking procedures as well as site-specific licensing procedures, access to agency information, and procedures and standards for judicial review of agency actions. All environmental rulemakings proposed and finalized by the EPA include public participation throughout the process.

Aggregation Points Centers that accept used oil only from places owned by the same owner and operator as the aggregation point, or from do-it- yourselfers.

Alternative Concentration Limits For purposes of TSDF ground water monitoring, hazardous constituent limits established by the EPA Regional Administrator that are allowed to be present in ground water.

Annual Aggregate For purposes of UST financial responsibility, the total amount of UST financial responsibility coverage required to cover all leaks that might occur in one year.

Applicable or Relevant and Appropriate Requirements Standards, criteria, or limitations under federal or more stringent state environmental laws, including RCRA, that may be required during a Superfund remedial action, unless site-specific waivers are obtained.

Authorized State A state that has been delegated the authority by the EPA to implement and enforce its own regulations for hazardous waste management under RCRA. The state program must be at least as stringent as the federal standards.

Automatic Tank Gauging A release detection method for USTs that uses a probe in the tank that is wired to a monitor to provide information on product level and temperature.

Basel Convention The international treaty that establishes standards for global trade of hazardous waste, municipal waste, and municipal incinerator ash. Because the United States is not a party to the convention, U.S. businesses can only export waste to those countries with which the U.S. government has negotiated a separate waste trade agreement.

Bentsen Wastes Geothermal exploration, development, and production waste exempt from RCRA Subtitle C regulation.

Best Demonstrated Available Technology The technology that best minimizes the mobility or toxicity (or both) of the hazardous constituents for a particular waste.

Bevill Wastes Fossil fuel combustion wastes, mining and mineral processing wastes, and cement kiln dust wastes exempt from RCRA Subtitle C regulation.

Biennial Report A report submitted by hazardous waste LQGs and TSDFs to enable the EPA and the states to track the quantities of hazardous waste generated and the movements of those hazardous wastes.

Boiler An enclosed device that uses controlled flame combustion to recover and deliver energy in the form of steam, heated fluid, or heated gases.

Bottom Ash Ash that collects at the bottom of a combustion chamber.

Burners Handlers who burn used oil for energy recovery in boilers, industrial furnaces, or hazardous waste incinerators.

Burning for Energy Recovery Burning hazardous waste for its heating value as a fuel, and using wastes to produce fuels or as ingredients in fuels.

By-Products Materials that are not one of the intended products of a production process and includes most wastes that are not spent materials or sludges.

California List Interim LDR treatment standards that ensured adequate protection of human health and the environment during the time the EPA was promulgating final LDR treatment standards.

Capacity Assurance Plan A written statement which ensures that a state has hazardous waste treatment and disposal capacity. This capacity must be for facilities that are in compliance with RCRA Subtitle C requirements and must be adequate to manage hazardous wastes projected to be generated within the state over 20 years.

Cathode Ray Tubes Vacuum tubes made primarily of glass, which constitute the video display component of televisions and computer monitors. These tubes are generally hazardous for lead.

Cathodic Protection A form of corrosion protection for USTs that uses sacrificial anodes or a direct current source to protect steel by halting the naturally occurring electrochemical process that causes corrosion.

Cement Kiln Type of industrial furnace that receives hazardous waste to burn as fuel to run its cement process. Cement is produced by heating mixtures of limestone and other minerals or additives at high temperatures in a rotary kiln, followed by cooling, grinding, and finish mixing.

Change in Service Using a formerly regulated UST system to store a nonregulated substance.

Characteristic Waste Waste that is considered hazardous under RCRA because it exhibits any of four different properties: ignitability, corrosivity, reactivity, and toxicity.

Civil Action A formal lawsuit, filed in court, against a person who has either failed to comply with a statutory or regulatory requirement or an administrative order, or against a person who has contributed to a release of hazardous waste or hazardous constituents.

Clean Air Act The Act that regulates air emissions from area, stationary, and mobile sources. CAA limits the emission of pollutants into the atmosphere in order to protect human health and the environment from the effects of airborne pollution.

Clean Closure The process of completely removing all waste that was treated, stored, or disposed in a hazardous waste unit.

Clean Water Act The Act that sets the basic structure for regulating discharges of pollutants to surface waters of the United States. CWA imposes contaminant limitations or guidelines for all discharges of wastewater into the nation's waterways.

Closure The procedure that a solid or hazardous waste management facility undergoes to cease operations and ensure protection of human health and the environment in the future.

Codification The process by which final regulations are incorporated into the CFR, which is published annually.

Collection Centers Centers that accept used oil from multiple sources, including both businesses and private citizens.

Combustion The controlled burning in an enclosed area as a means of treating or disposing of hazardous waste.

Commercial Chemical Products Unused or off-specification chemicals, spill or container residues, and other unused manufactured products that are not typically considered chemicals. For the purposes of hazardous waste listings, CCPs include only unused, pure chemical products and formulations.

Compliance Monitoring For purposes of RCRA TSDF ground water monitoring, a program that seeks to ensure that the amount of hazardous waste that has leaked into the uppermost aquifer does not exceed acceptable levels.

Composting Processes designed to optimize the natural decomposition or decay of organic matter, such as leaves and food. The end product of composting is a humus-like material that can be added to soils to increase soil fertility, aeration, and nutrient retention.

Comprehensive Environmental Response, Compensation, and Liability Act The Act that authorizes the EPA to clean up uncontrolled or abandoned hazardous waste sites and respond to accidents, spills and other emergency releases of hazardous substances. CERCLA provides the EPA with enforcement authority to ensure that responsible parties pay the cleanup costs of remediating a site contaminated with hazardous substances.

Comprehensive Environmental Response, Compensation, and Liability Information System A computerized database used to track hazardous substance sites.

Comprehensive Performance Testing The initial and periodic evaluation procedure for demonstrating compliance with the national emission standards for hazardous air pollutants and establishes revised operating limits for hazardous waste combustors.

Comprehensive Procurement Guidelines A list, updated every two years, which designates items with recycled content that procuring agencies should aim to purchase. This list currently contains 54 items within 8 product categories.

Concentration Limits For purposes of TSDF ground water monitoring, the maximum levels of hazardous constituents allowed to be present in the ground water.

Conditionally Exempt Small Quantity Generators Facilities that produce less than 100 kg of hazardous waste, or less than 1 kg of acutely hazardous waste, per calendar month. A CESQG may only accumulate less than 1,000 kg of hazardous waste, 1 kg of acutely hazardous waste, or 100 kg of spill residue from acutely hazardous waste at any one time.

Construction Quality Assurance A program required by the EPA to ensure that a landfill, surface impoundment, or waste pile meets all of the technological requirements.

Contained-In Policy An EPA policy that determines the health threats posed by contaminated environmental media and debris, and whether such materials must be managed as RCRA hazardous wastes.

Containers Portable devices, in which a material is stored, transported, treated, or otherwise handled.

Containment Building A completely enclosed structure used to store or treat noncontainerized waste.

Continuous Emission Monitoring Systems A system that directly and continuously measures one or more pollutants exiting a combustion unit.

Continuous Monitoring Systems A device which continuously samples the regulated parameter without interruption, evaluates the detector response at least once every 15 seconds, and computes and records the average value at least every 60 seconds.

Cooperative Agreement An agreement between a state and the EPA which ensures that the state will spend money from the LUST Trust Fund for its intended purpose.

Corporate Guarantee The demonstration that a corporate grandparent, corporate parent, or sibling corporation can meet financial assurance requirements on behalf of a TSDF owner and operator, or the financial responsibility requirements on behalf of a UST owner and operator. Firms with a "***substantial business relationship***" with a UST owner and operator can also make this demonstration.

Corrective Action An EPA program to address the investigation and cleanup of contamination from solid waste facilities, hazardous waste facilities, and USTs.

Corrective Action Management Unit A physical, geographical area designated by the EPA or states for managing remediation wastes during corrective action.

Corrosivity Characteristic The characteristic which identifies wastes that are acidic or alkaline (basic) and can readily corrode or dissolve flesh, metal, or other materials.

Counting Totaling the hazardous wastes at a given facility for a particular month in order to determine hazardous waste generator status.

Covered States States that participated in the EPA's medical waste tracking program from June 22, 1989 to June 22, 1991, which included Connecticut, New Jersey, New York, Rhode Island, and the Commonwealth of Puerto Rico.

Cradle to Grave The time period referring to the initial generation of hazardous waste to its ultimate disposal.

Criminal Action Enforcement action reserved for the most serious violations, which can result in fines or imprisonment.

De minimis Very small amounts of hazardous waste that are discharged to wastewater treatment facilities and thus, are exempt from the mixture rule. De minimis also refers to small concentrations of regulated substances in a UST.

Debris A broad category of large manufactured and naturally occurring objects that are commonly discarded (e.g., construction materials, decommissioned industrial equipment, discarded manufactured objects, tree trunks, boulders).

Delisting A site-specific petition process whereby a handler can demonstrate to the EPA that a particular wastestream generated at its facility that meets a listing description does not pose sufficient hazard to warrant RCRA regulation. Owners and operators can also use the delisting process for wastes that are hazardous under the mixture and derived-from rules that pose minimal hazard to human health and the environment.

Derived-From Rule A rule that regulates residues from the treatment of listed hazardous wastes.

Designated Facility A hazardous waste treatment, storage, or disposal facility which has received a RCRA permit (or interim status),or is a recycling facility regulated under 40 CFR Section 261.2(c)(2) or Subpart F, of Section 266,and has been designated on the manifest by the generator.

Destination Facilities Facilities that treat, dispose of, or recycle a particular category of universal waste.

Destruction and Removal Efficiency Standard which verifies that a combustion unit is destroying the organic components found in hazardous waste.

Detection Monitoring For purposes of RCRA TSDF ground water monitoring, the first step of monitoring at land disposal units, where the owner and operator monitors for indication of a leak from the unit, looking for potential changes in the ground water quality from normal (background)levels.

Dilution Prohibition The LDR requirement that prohibits the addition of soil or water to waste in order to reduce the concentrations of hazardous constituents instead of treatment by the appropriate LDR treatment standards.

Direct Discharges Discharges from point sources into surface water pursuant to a CWA NPDES permit.

Disposal The discharge, deposit, injection, dumping, spilling, leaking, or placing of any solid or hazardous waste on or in the land or water.

Disposal Prohibition The LDR requirement that prohibits the land disposal of hazardous waste that has not been adequately treated to reduce the threat posed by such waste.

Distillation Bottoms Residues that form at the bottom of a distillation unit.

Do-it-Yourselfers Individuals who generate used oil through the maintenance of their own personal vehicles and equipment and are not considered used oil generators.

Drip Pads Engineering structures consisting of a curbed, free-draining base, constructed of non-earthen materials, and designed to convey wood preservative chemical drippage from treated wood, precipitation, and surface water run-on to an associated collection system at wood preserving plants.

Elementary Neutralization Units Containers, tanks, tank systems, transportation vehicles, or vessels which neutralize wastes that are hazardous only for exhibiting the characteristic of corrosivity.

Emergency Planning and Community Right-to- Know Act The Act designed to help communities prepare to respond in the event of a chemical emergency and to increase the public's knowledge of the presence and threat of hazardous chemicals.

Environmental Justice The fair distribution of environmental risks across socioeconomic and racial groups.

Environmental Media Materials such as soil, surface water, ground water, and sediment.

EPA Identification Number A unique number assigned by the EPA to each hazardous waste generator, transporter, or treatment, storage, and disposal facility.

Episodic Generation The situation in which a generator's status changes from one month to the next, as determined by the amount of waste generated in a particular month. If a generator's status does in fact change, the generator is required to comply with the respective regulatory requirements for that class of generators for the waste generated in that particular month.

Equipment Each valve, pump, compressor, pressure relief device, sampling connection system, open-ended valve or line, or flange or other connector, and any other control devices or systems.

Exception Report A report, submitted by LQGs and SQGs, detailing efforts to locate wastes when a signed copy of the manifest has not been received.

Existing USTs USTs that were in service, or for which installation had commenced on or before December 22, 1988.

Extended Product Responsibility An approach to environmental protection that strives to reduce the environmental impacts of products.

Federal Insecticide, Fungicide, and Rodenticide Act The Act that provides procedures for the registration of pesticide products to control their introduction into the marketplace.

Federal Procurement Program A program that sets minimum recycled content standards for certain designated items and requires procuring agencies to purchase those items composed of the highest percentage of recovered materials practicable.

Final Authorization Authorization by the EPA that indicates that a state's program is equivalent to, or no less stringent than, as well as consistent with, federal hazardous waste regulations.

Financial Assurance Under RCRA Subtitle C, the requirements designed to ensure that TSDF owners and operators will have the financial resources to pay for closure, post-closure, and liability costs. Under RCRA Subtitle D, the requirements designed to ensure that MSWLF owners and operators will have the financial resources to pay for closure, post-closure, and corrective action costs.

Financial Test A test of self-insurance which demonstrates that an owner and operator has sufficient financial strength to satisfy TSDF financial assurance or UST financial responsibility requirements.

Float The lighter materials present in petroleum refinery wastewater. As components of oily waste, float rises to the surface in the first step of wastewater treatment.

Fly Ash Particles of ash, such as particulate matter which may also have metals attached to them, that are carried up the stack of a combustion unit with gases during combustion.

Formal Action An enforcement action, frequently in the form of an administrative order, that is taken when a serious violation is detected, or when the owner and operator does not respond to an informal administrative action.

Freedom of Information Act The Act that grants private parties the right to obtain information in the government’s possession. FOIA requires each federal agency to establish procedures for handling requests regarding government statutes, regulations, standards, permit conditions, requirements, orders, and policies.

Full Cost Accounting An accounting approach that helps local governments identify all direct and indirect costs, as well as the past and future costs, of a municipal solid waste management program.

Generator Any person whose act first creates or produces a hazardous waste, used oil, or medical waste, or first brings such materials into RCRA regulation.

Green Buildings Buildings that are designed, constructed, operated, and ultimately removed in such a way as to minimize their environmental impact.

Ground Water Monitoring Sampling and analysis of ground water for the purpose of detecting the release of contamination from a solid or hazardous waste land-based unit. Ground water monitoring is also a method of UST release detection which senses the presence of liquid product floating in ground water.

Hammer Provisions Requirements written directly into RCRA by Congress, as in the case of the Hazardous and Solid Waste Amendments of 1984, that would automatically become regulations if the EPA failed to issue its own regulations by certain dates.

Hazard Communication Standard The OSHA standard that provides workers with access to information about the hazards and identities of the chemicals they are exposed to while working, as well as the measures they can take to protect themselves.

Hazard Ranking System A model devised under CERCLA that determines the relative risk to public health and the environment posed by hazardous substances in ground water, surface water, air, and soil. Only those sites with a score of 28.5 (on a scale of 0 to 100) are eligible for placement on the NPL.

Hazardous Constituents For purposes of RCRA TSDF ground water monitoring, those constituents that have been detected in the uppermost aquifer and are reasonably expected to be in or derived from the waste contained in the unit.

Hazardous Substance A comprehensive designation under CERCLA for RCRA hazardous wastes as well as other toxic pollutants regulated by CAA, CWA, and TSCA. EPA has the authority under CERCLA to designate any additional element, compound, mixture, or solution as a hazardous substance. The definition of hazardous substance specifically excludes petroleum and natural gas.

Hazardous Waste A waste with properties that make it dangerous, or capable of having a harmful effect on human health and the environment. Under the RCRA program, hazardous wastes are specifically defined as wastes that meet a particular listing description or that exhibit a characteristic of hazardous waste.

Hazardous Waste Operations and Emergency Response Worker Protection Standard The OSHA standard that protects the health and safety of workers engaged in operations at hazardous waste sites, hazardous waste treatment facilities, and emergency response locations.

Ignitability characteristic The characteristic which identifies wastes that can readily catch fire and sustain combustion.

Incinerator An enclosed device that uses controlled flame combustion and does not meet the criteria for classification as a boiler, industrial furnace, sludge dryer (a unit that dehydrates hazardous sludge), or carbon regeneration unit (a unit that regenerates spent activated carbon). Incinerators also include infrared incinerators (units that use electric heat followed by a controlled flame afterburner) and plasma arc incinerators (units that use electrical discharge followed by a controlled flame afterburner).

Incorporation by Reference This occurs when the regulatory language in a state's regulation actually cite, or refer to, the federal regulations.

Indirect Discharges Wastewater that is first sent to a POTW, and then after treatment by the POTW, discharged pursuant to a NPDES permit.

Industrial Ecology The study of material and energy flows and their transformations into products, byproducts, and wastes throughout industrial and ecological systems.

Industrial Furnace An enclosed unit that is an integral part of a manufacturing process and uses thermal treatment to recover materials or energy from hazardous waste.

Informal Administrative Action Any communication from the EPA or a state agency that notifies the handler of a problem.

Inherently Waste-Like For purposes of defining a material as a solid waste under RCRA Subtitle C, a material, such as dioxin-containing wastes, that is always considered a solid waste because of its intrinsic threat to human health and the environment.

Insurance A policy to cover the TSDF financial assurance or UST financial responsibility requirements.

Interim Authorization A temporary mechanism that is intended to promote continued state participation in hazardous waste management while encouraging states to develop programs that are fully equivalent to the federal program and will qualify for final authorization.

Interim Measures Under RCRA Subtitle C corrective action, short-term actions to control ongoing risks while site characterization is underway or before a final remedy is selected.

Interim Status Facilities TSDFs that were already in operation when the RCRA standards were established and that are operating under less stringent standards until they receive a permit.

Interstitial Monitoring UST release detection method that involves the use of secondary containment, such as a barrier, outer wall, vault, or liner around the UST or piping to prevent leaking product from escaping into the environment. If product escapes from the inner tank or piping, it will then be directed towards an interstitial monitor
located between the walls.

Inventory Control An UST release detection method that involves taking measurements of tank contents, recording the amount of product pumped each operating day, and reconciling this data at least once a month to determine if a tank is leaking.

Jobs through Recycling A program the EPA launched in 1994 to support recycling markets. The goal of the program is to foster markets for recycled goods by promoting and assisting the development of businesses using recovered materials, creating new
recycling jobs, and spurring innovative technologies.

Lab Packs Drums filled with many small containers packed in nonbiodegradable absorbent materials.

Land Disposal For purposes of RCRA Subtitle C regulation, placement in or on the land, except in a corrective action unit of hazardous waste, and includes, but is not limited to, placement in a landfill, surface impoundment, waste pile, injection well, land treatment facility, salt dome formation, salt bed formation, underground mine or cave, or placement in a concrete vault, or bunker intended for disposal purposes.

Land Treatment Units Also known as land farms, land treatment units involve the application of hazardous waste on the soil surface, or the incorporation of waste into the upper layers of the soil in order to degrade, transform, or immobilize hazardous constituents present in hazardous waste.

Landfill For purposes of RCRA Subtitle C, a disposal unit where nonliquid hazardous waste is placed in or on the land.

Large Quantity Generators Facilities that generate more than 1,000 kg of hazardous waste per calendar month, or more than 1 kg of acutely hazardous waste per calendar month.

Large Quantity Handlers of Universal Waste
Handlers that accumulate a total of 5000 kg or more of universal waste at any one time.

Leachate Any liquid, including any suspended components in the liquid, that has percolated through or drained from waste.

Leaking Underground Storage Tank Trust Fund A fund created by SARA that provides money for overseeing corrective action taken by a responsible party, and provides money for cleanups at UST sites where the owner and operator is unknown, unwilling, or unable to respond.

Letter of Credit A credit document issued to an owner and operator to cover TSDF financial assurance or UST financial responsibility requirements.

Liabilities Damages that may result from an unexpected release of contaminants into the environment.

Lightweight Aggregate Kiln Type of industrial furnace that produces lightweight aggregate and burns liquid hazardous waste as fuel to run its process. Lightweight aggregate refers to a wide variety of raw materials (such as clay, shale, or slate) which, after thermal processing, can be combined with cement to form concrete products. Lightweight aggregate is produced either for structural or thermal insulation purposes.

Listed Wastes Wastes that are considered hazardous under RCRA because they meet specific listing descriptions.

Manifest Paperwork that accompanies hazardous waste from the point of generation to the point of ultimate treatment, storage, or disposal. Each party involved in the waste's management retains a copy of the RCRA manifest, which contains specific information about the waste.

Manual Tank Gauging A method of UST leak detection that requires keeping the tank undisturbed for at least 36 hours per week, during which time the contents of the tank are measured to determine if the tank is leaking.

Marine Protection, Research, and Sanctuaries Act This Act requires a permit for any material that is transported from a U.S. port or by a U.S. vessel for disposition at sea.

Marketers Used oil handlers who either 1) direct shipments of used oil to be burned as fuel in regulated devices, or 2) claim that used oil to be burned for energy recovery is on-specification.

Maximum Achievable Control Technology Process Technology-based concentration limits developed under CAA to limit emissions of individual constituents from hazardous waste combustion units.

Maximum Contaminant Levels For purposes of RCRA ground water monitoring, contaminant-specific levels borrowed from SDWA that are the maximum levels of hazardous waste or hazardous constituents allowed to be present in the groundwater.

Medical Waste Culture and stocks of infectious agents, human pathological wastes, human blood and blood products, used sharps, certain animal wastes, certain isolation wastes, and unused sharps.

Memorandum of Agreement An agreement between a state's director and its EPA Regional Administrator outlining the nature of the responsibilities to enforce a regulatory program and defining the level of coordination and oversight between the EPA and the state agency.

Military Munitions For purposes of defining a material as a solid waste under RCRA Subtitle C, ammunition products and components produced for or used by the military for national defense and security.

Miscellaneous Units Hazardous waste treatment, storage, or disposal units regulated under RCRA that do not meet any of the other definitions of regulated units.

Mixed Waste Radioactive waste that is also a hazardous waste under RCRA. Such wastes are jointly regulated by RCRA and the Atomic Energy Act.

Mixture Rule A rule that is intended to ensure the regulation of mixtures of listed wastes with nonhazardous solid wastes.

Municipal Solid Waste Durable goods (e.g., appliances, tires, batteries), nondurable goods (e.g., newspapers, books, magazines), containers and packaging, food wastes, yard trimmings, and miscellaneous or anic wastes from residential, commercial, and industrial nonprocess sources.

Municipal Solid Waste Landfill A discrete area of land or excavation that receives municipal solid waste.

National Ambient Air Quality Standards Regulations promulgated by the EPA under the Clean Air Act for six criteria pollutants — sulfur dioxide,, particulate matter, nitrogen dioxide, carbon monoxide, ozone, and lead — in order to protect the public from toxic emissions to the atmosphere.

National Corrective Action Prioritization System A resource management tool by which the EPA sets priorities for the Subtitle C corrective action program.

National Emission Standards for Hazardous Air Pollutants Standards set by the EPA under the Clean Air Act to control emissions from specific industrial sources.

National Oil and Hazardous Substances Pollution Contingency Plan The NCP contains the regulations that implement the CERCLA response process. The NCP also provides information about the roles and responsibilities of the EPA, other federal agencies, states, and private parties regarding releases of hazardous substances.

National Priorities List EPA's priority hazardous substance sites for cleanup. EPA only funds remedial actions at hazardous waste sites on the NPL.

New USTs USTs that are installed, or for which installation has commenced, after December 22, 1988.New USTs must be installed in compliance with all of the applicable technical standards.

Nonsudden Accidental Occurrences For purposes of TSDF financial assurance, events that take place over time and involve continuous or repeated exposure to hazardous waste.

Notice of Deficiency A notice requiring that a TSDF permit applicant supply more information for a complete permit application.

Notice of Intent to Deny A notice issued by a permitting agency which tells a TSDF permit applicant that the application does not demonstrate compliance with the RCRA standards.

Notice of Noncompliance An informal letter to a handler written as part of an informal administrative action.

Notice of Violation An informal letter to a handler written as part of an informal administrative action.

Occupational Safety and Health Act The Act that is designed to save lives, prevent injuries, and protect the health of employees in the workplace. OSHA accomplishes these goals through several regulatory requirements including the HCS and HAZWOPER standards.

OECD Council Decision A multilateral agreement by the Organization for Economic Cooperation and Development that establishes procedural and substantive controls for the import and export of recyclables between member nations. Because the United States is a member of the OECD, U.S. businesses can trade recyclables with other member nations.

Off-Specification Used Oil Used oil that is tested and does not meet given parameters for arsenic, cadmium, chromium, flash point, lead, and total halogens.

Omnibus Provision The authority which allows the EPA to add conditions to a TSDF permit that are not specifically addressed by the RCRA regulations.

On-Specification Used Oil Used oil that meets all the given parameters for arsenic, cadmium, chromium, flash point, lead, and total halogens.

Open Dumps Solid waste disposal facilities that fail to comply with the Subtitle D criteria.

Operating Requirements Parameters established by a facility and written into a permit that will ensure a combustion unit meets numerical performance standards.

Operation and Maintenance The operation and maintenance phase of the CERCLA response process. Operation and maintenance may include activities such as ground water pump and treat, and cap maintenance. The EPA conducts review of operation and maintenance activities to ensure that the remedy selected is still protective of human health and the environment.

Overfilling When a state fails to enforce its hazardous waste program properly, the EPA can overfile, or enforce a provision for which a particular state has authorization.

Particulate Matter Small dust-like particles emitted from hazardous waste combustion units.

Payment Bond For purposes of TSDF financial assurance, a type of surety bond that will fund a standby trust fund in the amount equal to the value of the bond.

Per Occurrence For purposes of UST financial responsibility, the amount of money that must be available to pay for the costs from one leak.

Performance Bond For purposes of TSDF financial assurance, a type of surety bond that guarantees that an owner and operator will comply with their closure, post-closure, and liability requirements.

Performance Standards The numerical pollutant emission limits for hazardous waste combustion units developed by the EPA.

Permanent Closure Closure of a UST that involves a number of steps designed to ensure that the tank will pose no threat to human health or the environment after it is closed.

Permit-as-a-Shield The provision which ensures that TSDF permittees will not be enforced against for violating new requirements that were not established in the original permit.

Permit-by-Rule A special form of a RCRA permit that is sometimes granted to facilities with permits for activities under other environmental laws.

Permitted Facilities Facilities that have obtained a TSDF permit from the EPA or the state agency to engage in the treatment, storage, or disposal of hazardous waste.

Point of Compliance For purposes of RCRA TSDF ground water monitoring, the vertical point where a TSDF owner and operator must monitor the uppermost aquifer to determine if the leak exceeds the ground water protection standard.

Point Source Discharges Discharges of treated wastewater directly into a lake, river, stream, or other water body. Point source discharges are regulated under CWA.

Pollutants or Contaminants Any element, substance, compound, or mixture that, after release into the environment and upon exposure, ingestion, inhalation, or assimilation into any organism, will or may reasonably be anticipated to cause illness, death, or deformation in any organism. The definition of pollutant or contaminant specifically excludes petroleum and natural gas.

Post-Closure Period after closure during which owners and operators of solid or hazardous waste disposal units conduct monitoring and maintenance activities in order to preserve the integrity of the disposal system.

Potentially Responsible Party The person or persons who may be held liable for hazardous substance contamination under CERCLA. PRPs may include the owners and operators, generators, transporters, and disposers of the hazardous substances.

Precious Metals Reclamation The recycling and recovery of precious metals (i.e., gold, silver, platinum, palladium, iridium, osmium rhodium, and ruthenium) from hazardous waste.

Preliminary Assessment A review of all readily available site information such as maps, deeds, and other records to determine if further CERCLA response action is necessary. During the PA, the EPA tries to determine what type of substances may have
been released and the potential impacts to human health and the environment.

Principal Organic Hazardous Constituents Selected or anic constituents, which are high in concentration and difficult to burn, that are monitored to ensure a hazardous waste combustion unit's destruction and removal efficiency.

Process Vent Any open-ended pipe or stack that is vented to the atmosphere either directly, through a vacuum-producing system, or through a tank associated with hazardous waste distillation, fractionation, thin-film evaporation solvent extraction, or air or steam stripping operations.

Processors and Rerefiners Facilities that process used oil so that it can be burned for energy recovery or reused.

Procuring Agency Agencies that purchase $10,000 or more worth of an item designated under the federal procurement program during the course of a fiscal year. Procuring agencies include: federal government departments or agencies; state government agencies that use appropriated federal funds for procurement of a designated item; local government agencies that use appropriated federal funds for procurement of a designated item, and government contractors that work on a project funded by appropriated federal funds with respect to work performed under the contract.

Publicly Owned Treatment Works A municipal wastewater treatment plant that receives domestic sewage from households, office buildings, factories, and other places where people live and work. Treatment at a POTW is regulated by the CWA.

RCRAInfo A database that tracks RCRA Subtitle C facility-specific data (i.e., events and activities related to hazardous waste generators, transporters, and TSDFs), and hazardous waste activity reports, known as biennial reports, that are submitted by LQGs and TSDFs.

Reactivity Characteristic The characteristic which identifies wastes that readily explode or under violent reactions.

Rebuttable Presumption For purposes of RCRA, an objective test that focuses on the halogen level in used oil to determine whether the used oil has been mixed with a listed hazardous waste.

Reclaimed For purposes of defining a material as a solid waste under RCRA Subtitle C, a material is reclaimed if it is processed to recover a usable product, or regenerated by processing it in a way that restores it to usable condition.

Record of Decision A remedial action plan document that describes the remedy selected for a Superfund site.

Recovered Materials Advisory Notice A notice that provides suggested recycled content levels and other purchasing information for each item designated in the CPG. Procuring agencies can use these levels as guidelines, but are encouraged to exceed the EPA's recommendations.

Recovered Materials Content Levels The minimum amount of recovered material that designated items under the federal procurement program should contain.

Recycled For purposes of defining a material as a solid waste under RCRA Subtitle C, a material is recycled if it is used or reused, or reclaimed.

Recycling The separation and collection of wastes, their subsequent transformation or remanufacture into usable or marketable products or materials, and the purchase of products made from recyclable materials.

Recycling Presumption The assumption that all used oil that is generated will be recycled.

Regulated Community The group of organizations, people, industries, businesses, and agencies that, because they perform certain activities, fall under the purview of RCRA.

Regulated Substance For purposes of UST regulation, any hazardous substance defined under CERCLA §101(14) and petroleum.

Regulations Rules issued by an agency, such as the EPA, that translate the general mandate of a statute into a set of requirements that the regulated community and the agency must work within.

Remedial Action Longer-term CERCLA response actions that ultimately represent the final remedy for a site and generally are more expensive and of a longer duration than removals.

Remedial Action Plans Special form of RCRA permit that a facility may obtain to treat, store, or dispose of hazardous remediation waste at a remediation waste management site.

Remedial Design/Remedial Action Remedial design is a phase in the CERCLA response process in which technical drawings are developed for the chosen remedy, costs for implementing the remedy are estimated, and roles and responsibilities of the EPA, states and contractors are determined. During the remedial action phase, the remedy is implemented generally by a contractor, with oversight and inspection conducted by the EPA or the state (or both).

Remedial Investigation/Feasibility Study A remedial investigation is a phase in the CERCLA response process that entails an in-depth examination of the nature and extent of contamination at a site and the associated risks to human health and the environment. The feasibility study entails an analysis of remedial action alternatives comparing the advantages and disadvantages of each.

Remediation Waste All solid and hazardous wastes, and all media (including ground water, surface water, soils, and sediments) and debris that are managed for implementing cleanup.

Removal Action Short-term cleanup action taken under CERCLA that usually addresses problems only at the surface of a site. A removal is conducted in response to an emergency, and generally is limited to 12 months duration or $2 million in expenditures.

Risk Retention Groups For purposes of UST financial responsibility, entities formed by businesses or individuals with similar risks to provide insurance coverage for those risks.

Risk-Based Decision-Making A process that uses risk and exposure assessment concepts to help UST implementing agencies establish enforcement priorities.

Rulemakings Rules issued by an agency, such as the EPA, that translate the general mandate of a statute into a set of requirements that the regulated community and the agency must work within.

Safe Drinking Water Act The Act designed to protect the nation's drinking water supply by establishing national drinking water standards (MCLs or specific treatment techniques),and by regulating UIC wells.

Scrap Metal Worn or extra bits and pieces of metal parts, such as scrap piping and wire, or worn metal items, such as scrap automobiles and radiators.

Secondary Materials The five categories of solid wastes regulated under Subtitle C, which include: spent materials, by-products, sludges, commercial chemical products, and scrap metal.

Sham Recycling Illegitimate activities executed under the guise of recycling in order to be exempt from or subject to lesser regulation.

Site Inspection An in-depth assessment of on-site conditions, conducted as part of the CERCLA response process, to rank the site's hazard potential by determining the site's hazard ranking system score. Activities to assess the site may include sampling, field reconnaissance, and examination of site records (e.g., topographical maps, logs).

Sludges Any solid, semisolid, or liquid wastes generated from a wastewater treatment plant, water supply treatment plant, or air pollution control device.

Small Quantity Generators Facilities that generate between 100 kg and 1,000 kg of hazardous waste per calendar month.

Small Quantity Handlers of Universal Waste Handlers that do not accumulate 5000 kg of all universal waste categories combined at their location at any one time.

Sole Active Ingredient For purposes of determining if a waste is P or U listed the only chemical ingredient serving the function of a commercial product formulation.

Solid Waste Any garbage, refuse, sludge from a wastewater treatment plant, water supply treatment plant, or air pollution control facility, and other discarded material, including solid, liquid, semisolid, or contained gaseous material, resulting from industrial, commercial, mining, and agricultural operations and from community activities. For the purposes of hazardous waste regulation, a solid waste is a material that is discarded by being either abandoned, inherently waste-like, a certain waste military munition, or recycled.

Solid Waste Management Units For purposes of Subtitle C corrective action, discernible units where solid or hazardous wastes have been placed at any time, or any area where solid wastes have been routinely and systematically released.

Source Reduction Maximizing or reducing the use of natural resources at the beginning of an industrial process, thereby eliminating the amount of waste produced by the process. Source reduction is the EPA's preferred method of waste management.

Spent Materials Materials that have been used and can no longer serve the purpose for which they were produced without processing.

Spill Prevention Control and Countermeasures Regulations establishing spill prevention procedures and equipment requirements for nontransportation-related facilities with certain aboveground or underground storage capacities that could reasonably be expected to discharge oil into or upon the navigable waters of the United States or adjoining shorelines.

Staging Pile An accumulation of solid, non-flowing remediation waste that is not a containment building and that is used only during remedial operations for temporary storage at a facility.

State Assurance Funds For purposes of UST financial responsibility, state funds that are used to help pay for cleanup and third-party liability costs resulting from leaking USTs.

State Authorization Tracking System A tool used by the EPA to chart those states that have been authorized to implement the RCRA hazardous waste program.

Statistical Inventory Reconciliation A UST release detection method that involves using sophisticated computer software to conduct a statistical analysis of inventory, delivery, and dispensing data in order to determine if a tank is leaking.

Storage Holding hazardous waste for a temporary period, after which the hazardous waste is treated, disposed of, or stored elsewhere.

Storage Prohibition LDR provision that prevents the indefinite storage of untreated hazardous waste for reasons other than the accumulation of quantities necessary for effective treatment or disposal.

Sudden Accidental Occurrences For purposes of TSDF financial assurance, events that are not continuous or repeated.

Superfund The common name for CERCLA. Superfund refers to the entire CERCLA program as well as the trust fund established to fund cleanup of contaminated sites where potentially responsible parties cannot be identified, or are unwilling or unable to pay.

Superfund Amendments and Reauthorization Act SARA, enacted in 1986, reauthorized and amended CERCLA to include additional enforcement authorities, technical requirements, community involvement requirements, and various clarifications. SARA Title III authorized EPCRA.

Supplemental Environmental Projects Environmentally beneficial projects which a defendant or respondent agrees to undertake in the settlement of a civil or administrative enforcement action, but which the defendant is not otherwise legally required to perform.

Surety Bond A guarantee which certifies that a surety company will cover TSDF financial assurance or UST financial responsibility requirements on behalf of the owner and operator.

Surface Impoundment A natural topographic depression, man-made excavation, or diked area formed primarily of earthen materials that is used to treat, store, or dispose of hazardous waste.

Tank Tightness Testing A variety of UST release detection methods used to determine if a tank is leaking; most of these methods involve monitoring changes in product level or volume in a tank over a period of several hours.

Tanks Stationary devices used to store or treat hazardous waste.

Technical Grade For purposes of determining if a waste is P or U listed, a commercial chemical product that is not 100 percent pure, but is of a grade of purity that is either marketed or recognized in general usage by the chemical industry.

Temporary Closure A method by which a UST owner and operator can close a tank temporarily and bring it back into service at a later date. The owner and operator must continue to operate and maintain the corrosion protection system and the leak detection system if any product remains in the tank.

Temporary Units Containers or tanks that are designed to manage remediation wastes during corrective action at permitted or interim status facilities.

Thermal Treatment The treatment of hazardous waste in a device that uses elevated temperatures as the primary means to change the chemical, physical, or biological character or composition of the waste.

Totally Enclosed Treatment Units Units that are designed and constructed to practically eliminate the potential for hazardous wastes to escape into the environment during treatment.

Toxic Substances Control Act The Act that controls the manufacture and sale of certain chemical substances.

Toxicity Characteristic The characteristic which identifies wastes that are likely to leach dangerous concentrations of toxic chemicals into ground water.

Toxicity Characteristic Leaching Procedure A lab procedure designed to predict whether a particular waste is likely to leach chemicals into ground water at dangerous levels.

Transfer Facilities Any transportation-related facility such as loading docks, parking areas, storage areas, or other similar areas where shipments of hazardous waste, used oil, or universal waste are held temporarily during the normal course of transportation.

Transporter Any person engaged in the off-site transportation of hazardous waste, used oil, universal waste, or medical waste.

Treatment Any method, technique, or process designed to physically, chemically, or biologically change the nature of a hazardous waste.

Treatment Standards LDR criteria that hazardous waste must meet before it is disposed.

Treatment, Storage, and Disposal Facilities Facilities engaged in the treatment, storage, or disposal of hazardous waste. These facilities are the last link in the cradle-to-grave hazardous waste management system.

Trial Burn Burn conducted to test the performance of a hazardous waste combustion unit over a range of conditions.

Trust Fund A financial mechanism by which a facility can set aside money in order to cover the TSDF financial assurance or UST financial responsibility requirements.

Underground Injection Control Well Units into which hazardous waste is permanently disposed of by injection 1/4 mile below an aquifer with an underground source of drinking water (as defined under SDWA).

Underground Storage Tanks A tank and any underground piping connected to the tank that is used to contain an accumulation of regulated substances and that has at least 10 percent of its combined volume underground.

Underlying Hazardous Constituents Constituents that must be treated in order to meet contaminant-specific levels for purposes of the LDR program.

Unit Pricing An economic incentive program used to achieve source reduction and recycling, also called variable rate refuse collection, where customers who dispose of more waste pay more for the collection and disposal services.

Universal Treatment Standards Contaminant-specific hazardous waste LDR treatment levels.

Universal Wastes Commonly recycled wastes with special management provisions intended to facilitate recycling. There are four categories of universal wastes: hazardous waste batteries, hazardous waste pesticides that have been recalled or collected in waste pesticide collection programs, hazardous waste lamps, and hazardous waste thermostats.

Upgrading Retrofitting existing USTs to come into compliance with the UST regulations. The upgrading period expires on December 22,1998.

Use Constituting Disposal The direct placement of wastes or waste-derived products (e.g., asphalt with petroleum refining wastes as an ingredient) on the land.

Used Oil Any oil that has been refined from crude or synthetic oil that has been used and, as a result of such use, is contaminated by physical or chemical impurities.

UST field Abandoned or underutilized industrial and commercial properties where redevelopment is complicated by real or perceived environmental petroleum contamination from federally-regulated USTs.

Vapor Monitoring A UST release detection method in which the equipment measures product fumes in the soil around the UST to check for leaks.

Violation The act or an instance of breaking or disregarding the law.

Waste Analysis Plan A plan that outlines the procedures necessary to ensure proper treatment, storage, or disposal of hazardous waste.

Waste Minimization The reduction, to the extent feasible, in the amount of hazardous waste generated prior to any treatment, storage, or disposal of the waste. Because waste minimization efforts eliminate waste before it is generated, disposal costs may be reduced, and the impact on the environment may be lessened.

Waste Pile An open pile used for treating or storing nonliquid hazardous waste.

Wastewater Treatment Units Tanks or tank systems that treat hazardous wastewaters and discharge them pursuant to CWA.

WasteWi$e A program designed to assist companies, states, local governments, Native American tribes, and other institutions in developing cost-effective practices to reduce solid waste.

Zero Discharges Wastewater that is not directly or indirectly discharged to a navigable water (e.g., wastewater that is land disposed through spray irrigation) under CWA. Zero discharge facilities are subject to federal or state regulatory limitations that are as strict as those that apply to direct and indirect dischargers under CWA.

ENVIRONMENTAL CONTACTS EPA INFORMATION SERVICES

Center for Environmental Research and Information (CERI),
Office of Research and Development (ORD).....(513)569-7562
www.epa.gov/ORD/publications

Clean Air Technology Center .....(919)541-0800
www.epa.gov/ttn/catc

Environmental Appeals Board (EAB).....(201)501-7060
www.epa.gov/eab

Environmental Justice Hotline .....(800)962-6215
www.epa.gov/compliance/environmentaljustice/index.html

Environmental Recycling Hotline/Earth 's 911.....(800)253-2687
www.earth911.org

Human Resources.....(202)564-4606
www.epa.gov/epahrist

Indoor Air Quality Clearinghouse .....(800)438-4318
www.epa.gov/iaq

Information Resource Center (IRC).....(202)260-5922
www.epa.gov/natlibra/hqirc

Methods Information Communication Exchange
(MICE or Test Methods Hotline).....(703)676-4690
www.epa.gov/epaoswer/hazwaste/test/mice.htm

National Lead Information Center .....(800)424-5323
www.epa.gov/lead/nlic.htm

National Radon Hotline .....(800)767-7236
www.epa.gov/iaq/radon/

National Service Center for Environmental Publications.....(800)490-9198
www.epa.gov/ncepihom/G-2

National Pesticides Information Center;
Federal Insecticide, Fungicide, and Rodenticide Act .....(800)858-7378
npic.orst.edu/

Office of Atmospheric Programs .....(202)564-9140
www.epa.gov/ozone

Office of Congressional &Intergovernmental Relations .....(202)564-5200
www.epa.gov/ocir

Pay-As-You-Throw Helpline .....(888)372-7298
www.epa.gov/payt

RCRA, Superfund & EPCRA Call Center .....(800)424-9346
www.epa.gov/epaoswer/hotline

Safe Drinking Water Hotline .....(800)426-4791
www.epa.gov/safewater

Toxic Substances Control Act Hotline .....(202)554-1404

WasteWise .....(800)372-9473
www.epa.gov/wastewise

Wetlands Protection Hotline .....(800)832-7828
www.epa.gov/owow/wetlands/wetline.html

EPA DOCKETS

Office of Air and Radiation .....(202)566-1742

Office of Enforcement and Compliance Assurance .....(202)566-1514

Office of Solid Waste and Emergency Response
RCRA/UST .....(202)566-0270

Superfund/Oil .....(202)566-0276

Office of Environmental Information (Toxics Release Inventory).....(202)566-1752

Office of Pollution, Prevention, and Toxics .....(202)566-0280

Office of Water .....(202)566-2426

FEDERAL GOVERNMENT INFORMATION SERVICES

Agency for Toxic Substances and Disease Registry TSDR).....(888)422-8737
www.atsdr.cdc.gov/

Council for Environmental Quality; National Environmental Policy Act .....(202)395-5750
www.whitehouse.gov/ceq

Federal Consumer Information Center .....(800)333-4636
www.pueblo.gsa.gov

Federal Information Center .....(800)688-9889
www.info.gov

Government Printing Office.....(202)512-1800
www.access.gpo.gov

Hazardous Materials Information Center .....(800)467-4922
hazmat.dot.gov

National Technical Information Service .....(800)553-6847
www.ntis.gov

National Institute for Occupational Safety and Health (NIOSH).....(800)356-4647
www.cdc.gov/niosh

National Response Center .....(800)424-8802
www.nrc.uscg.mil

Nuclear Regulatory Commission .....(301)415-8200
www.nrc.gov

Occupational Safety and Health Administration (OSHA)
Compliance Guidance Group .....(301)515-6796

Health hazard means a chemical, mixture of chemicals or a pathogen for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur in exposed employees.

OSHA RULE § 1910.1450 Occupational exposure to hazardous chemicals in laboratories.

(a) Scope and application. (1) This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.

(2) Where this section applies, it shall supersede, for laboratories, the requirements of all other OSHA health standards in 29 CFR part 1910, subpart Z, except as follows:

(i) For any OSHA health standard, only the requirement to limit employee exposure to the specific permissible exposure limit shall apply for laboratories, unless that particular standard states otherwise or unless the conditions of paragraph (a) (2) (iii) of this section apply.

(ii) Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.

(iii) Where the action level (or in the absence of an action level, the permissible exposure limit) is routinely exceeded for an OSHA regulated substance with exposure monitoring and medical surveillance requirements, paragraphs (d) and (g)(1)(ii) of this section shall apply.

(3) This section shall not apply to:

(i) Uses of hazardous chemicals which do not meet the definition of laboratory use, and in such cases, the employer shall comply with the relevant standard in 29 CFR part 1910, subpart Z, even if such use occurs in a laboratory.

(ii) Laboratory uses of hazardous chemicals which provide no potential for employee exposure. Examples of such conditions might include:

(A) Procedures using chemically-impregnated test media such as Dip-and-Read tests where a reagent strip is dipped into the specimen to be tested and the results are interpreted by comparing the color reaction to a color chart supplied by the manufacturer of the test strip; and

(B) Commercially prepared kits such as those used in performing pregnancy tests in which all of the reagents needed to conduct the test are contained in the kit.

(b) Definitions --

Action level means a concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight (8)-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance.

Assistant Secretary means the Assistant Secretary of Labor for Occupational Safety and Health, U.S. Department of Labor, or designee.

Carcinogen (see select carcinogen).

Chemical Hygiene Officer means an employee who is designated by the employer, and who is qualified by training or experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

Chemical Hygiene Plan means a written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment and work practices that (i) are capable of protecting employees from the health hazards presented by hazardous chemicals used in that particular workplace and (ii) meets the requirements of paragraph (e) of this section.

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

Compressed gas means:

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

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

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

Designated area means an area which may be used for work with "select carcinogens," reproductive toxins or substances which have a high degree of acute toxicity. A designated area may be the entire laboratory, an area of a laboratory or a device such as a laboratory hood.

Emergency means any occurrence such as, but not limited to, equipment failure, rupture of containers or failure of control equipment which results in an uncontrolled release of a hazardous chemical into the workplace.

Employee means an individual employed in a laboratory workplace who may be exposed to hazardous chemicals in the course of his or her assignments.

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

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

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

(ii) Gas, flammable means:

(A) A gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13 percent by volume or less; or

(B) A gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12 percent by volume, regardless of the lower limit.

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

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

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

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

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

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

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

Hazardous chemical means a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or

chronic health effects may occur in exposed employees. The term "health hazard" includes chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, and neurotoxins, agents which act on the hematopoietic systems and agents which damage the lungs, skin, eyes, or mucous membranes.

Appendices A and B of the Hazard Communication Standard (29 CFR 1910.1200) provide further guidance in defining the scope of health hazards and determining whether or not a chemical is to be considered hazardous for purposes of this standard.

Laboratory means a facility where the "laboratory use of hazardous chemicals" occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.

Laboratory scale means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. "Laboratory scale" excludes those workplaces whose function is to produce commercial quantities of materials.

Laboratory-type hood means a device located in a laboratory, enclosure on five sides with a moveable sash or fixed partial enclosed on the remaining side; constructed and maintained to draw air from the laboratory and to prevent or minimize the escape of air contaminants into the laboratory; and allows chemical manipulations to be conducted in the enclosure without insertion of any portion of the employee's body other than hands and arms.

Walk-in hoods with adjustable sashes meet the above definition provided that the sashes are adjusted during use so that the airflow and the exhaust of air contaminants are not compromised and employees do not work inside the enclosure during the release of airborne hazardous chemicals.

Laboratory use of hazardous chemicals means handling or use of such chemicals in which all of the following conditions are met:

(i) Chemical manipulations are carried out on a "laboratory scale;"

(ii) Multiple chemical procedures or chemicals are used;

(iii) The procedures involved are not part of a production process, nor in any way simulate a production process; and

(iv) "Protective laboratory practices and equipment" are available and in common use to minimize the potential for employee exposure to hazardous chemicals.

Medical consultation means a consultation which takes place between an employee and a licensed physician for the purpose of determining what medical examinations or procedures, if any, are appropriate in cases where a significant exposure to a hazardous chemical may have taken place.

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

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

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

Protective laboratory practices and equipment means those laboratory procedures, practices and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

Reproductive toxins means chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis)

Select carcinogen means any substance which meets one of the following criteria:

(i) It is regulated by OSHA as a carcinogen; or

(ii) It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or

(iii) It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or

(iv) It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:

(A) After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 ug 3 ;

(B) After repeated skin application of less than 300 (ug/kg of body weight) per week; or

(C) After oral dosages of less than 50 ug/kg of body weight per day.

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

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

(c) Permissible exposure limits. For laboratory uses of OSHA regulated substances, the employer shall assure that laboratory employees' exposures to such substances do not exceed the permissible exposure limits specified in 29 CFR part 1910, subpart Z.

(d) Employee exposure determination -- (1) Initial monitoring. The employer shall measure the employee's exposure to any substance regulated by a standard which requires monitoring if there is reason to believe that exposure levels for that substance routinely exceed the action level (or in the absence of an action level, the PEL).

(2) Periodic monitoring. If the initial monitoring prescribed by paragraph (d) (1) of this section discloses employee exposure over the action level (or in the absence of an action level, the PEL), the employer shall immediately comply with the exposure monitoring provisions of the relevant standard.

(3) Termination of monitoring. Monitoring may be terminated in accordance with the relevant standard.

(4) Employee notification of monitoring results. The employer shall, within 15 working days after the receipt of any monitoring results, notify the employee of these results in writing either individually or by posting results in an appropriate location that is accessible to employees.

(e) Chemical hygiene plan -- General. (Appendix A of this section is non-mandatory but provides guidance to assist employers in the development of the Chemical Hygiene Plan.)

(1) Where hazardous chemicals as defined by this standard are used in the workplace, the employer shall develop and carry out the provisions of a written Chemical Hygiene Plan which is:

(i) Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and

(ii) Capable of keeping exposures below the limits specified in paragraph (c) of this section.

(2) The Chemical Hygiene Plan shall be readily available to employees, employee representatives and, upon request, to the Assistant Secretary.

(3) The Chemical Hygiene Plan shall include each of the following elements and shall indicate specific measures that the employer will take to ensure laboratory employee protection:

(i) Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;

(ii) Criteria that the employer will use to determine and implement control measures to reduce employee exposure to hazardous chemicals including engineering controls, the use of personal protective equipment and hygiene practices; particular attention shall be given to the selection of control measures for chemicals that are known to be extremely hazardous;

(iii) A requirement that fume hoods and other protective equipment are functioning properly and specific measures that shall be taken to ensure proper and adequate performance of such equipment;

(iv) Provisions for employee information and training as prescribed in paragraph (f) of this section;

(v) The circumstances under which a particular laboratory operation, procedure or activity shall require prior approval from the employer or the employer's designee before implementation;

(vi) Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section;

(vii) Designation of personnel responsible for implementation of the Chemical Hygiene Plan including the assignment of a Chemical Hygiene Officer and, if appropriate, establishment of a Chemical Hygiene Committee; and

(viii) Provisions for additional employee protection for work with particularly hazardous substances. These include "select carcinogens," reproductive toxins and substances which have a high degree of acute toxicity. Specific consideration shall be given to the following provisions which shall be included where appropriate:

(A) Establishment of a designated area;

(B) Use of containment devices such as fume hoods or glove boxes;

(C) Procedures for safe removal of contaminated waste; and

(D) Decontamination procedures.

(4) The employer shall review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and update it as necessary.

(f) Employee information and training. (1) The employer shall provide employees with information and training to ensure that they are apprised of the hazards of chemicals present in their work area.

(2) Such information shall be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignments involving new exposure situations. The frequency of refresher information and training shall be determined by the employer.

(3) Information. Employees shall be informed of:

(i) The contents of this standard and its appendices which shall be made available to employees;

(ii) The location and availability of the employer's Chemical Hygiene Plan;

(iii) The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;

(iv) Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

(v) The location and availability of known reference material on the hazards, safe handling, storage and disposal of hazardous chemicals found in the laboratory including, but not limited to, Material Safety Data Sheets received from the chemical supplier.

(4) Training. (i) Employee training shall include:

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

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

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

(ii) The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.

(g) Medical consultation and medical examinations. (1) The employer shall provide all employees who work with hazardous chemicals an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

(i) Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate medical examination.

(ii) Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.

(iii) Whenever an event takes place in the work area such as a spill, leak, explosion or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. Such consultation shall be for the purpose of determining the need for a medical examination.

(2) All medical examinations and consultations shall be performed by or under the direct supervision of a licensed physician and shall be provided without cost to the employee, without loss of pay and at a reasonable time and place.

(3) Information provided to the physician. The employer shall provide the following information to the physician:

(i) The identity of the hazardous chemical(s) to which the employee may have been exposed;

(ii) A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

(iii) A description of the signs and symptoms of exposure that the employee is experiencing, if any.

(4) Physician's written opinion. (i) For examination or consultation required under this standard, the employer shall obtain a written opinion from the examining physician which shall include the following:

(A) Any recommendation for further medical follow-up;

(B) The results of the medical examination and any associated tests;

(C) Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous chemical found in the workplace; and

(D) A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

(ii) The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

(h) Hazard identification. (1) With respect to labels and material safety data sheets:

(i) Employers shall ensure that labels on incoming containers of hazardous chemicals are not removed or defaced.

(ii) Employers shall maintain any material safety data sheets that are received with incoming shipments of hazardous chemicals, and ensure that they are readily accessible to laboratory employees.

(2) The following provisions shall apply to chemical substances developed in the laboratory:

(i) If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the employer shall determine if it is a hazardous chemical as defined in paragraph (b) of this section. If the chemical is determined to be hazardous, the employer shall provide appropriate training as required under paragraph (f) of this section.

(ii) If the chemical produced is a byproduct whose composition is not known, the employer shall assume that the substance is hazardous and shall implement paragraph (e) of this section.

(iii) If the chemical substance is produced for another user outside of the laboratory, the employer shall comply with the Hazard Communication Standard (29 CFR 1910.1200) including the requirements for preparation of material safety data sheets and labeling.

(i) Use of respirators. Where the use of respirators is necessary to maintain exposure below permissible exposure limits, the employer shall provide, at no cost to the employee, the proper respiratory equipment. Respirators shall be selected and used in accordance with the requirements of 29 CFR 1910.134.

(j) Recordkeeping. (1) The employer shall establish and maintain for each employee an accurate record of any measurements taken to monitor employee exposures and any medical consultation and examinations including tests or written opinions required by this standard.

(2) The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.20.

(k) Dates -- (1) Effective date. This section shall become effective May 1, 1990.

(2) Start-up dates. (i) Employers shall have developed and implemented a written Chemical Hygiene Plan no later than January 31, 1991.

(ii) Paragraph (a) (2) of this section shall not take effect until the employer has developed and implemented a written Chemical Hygiene Plan.

(l) Appendices. The information contained in the appendices is not intended, by itself, to create any additional obligations not otherwise imposed or to detract from any existing obligation.

Appendix A to § 1910.1450 -- National Research Council Recommendations Concerning Chemical Hygiene in Laboratories (Non-Mandatory)

Table of Contents

1. Minimize all Chemical Exposures

2. Avoid Underestimation of Risk

3. Provide Adequate Ventilation

4. Institute a Chemical Hygiene Program

5. Observe the PELs and TLVs

B. Responsibilities

1. Chief Executive Officer

2. Supervisor of Administrative Unit

3. Chemical Hygiene Officer

4. Laboratory Supervisor

5. Project Director

6. Laboratory Worker

C. The Laboratory Facility

1. Design

2. Maintenance

3. Usage

4. Ventilation

D. Components of the Chemical Hygiene Plan

1. Basic Rules and Procedures

2. Chemical Procurement, Distribution, and Storage

3. Environmental Monitoring

4. Housekeeping, Maintenance and Inspections

5. Medical Program

6. Personal Protective Apparel and Equipment

7. Records

8. Signs and Labels

9. Spills and Accidents

10. Training and Information

11. Waste Disposal

E. General Procedures for Working With Chemicals

1. General Rules for all Laboratory Work with Chemicals

2. Allergens and Embryotoxins

3. Chemicals of Moderate Chronic or High Acute Toxicity

4. Chemicals of High Chronic Toxicity

5. Animal Work with Chemicals of High Chronic Toxicity

F. Safety Recommendations

G. Material Safety Data Sheets

Foreword

As guidance for each employer's development of an appropriate laboratory Chemical Hygiene Plan, the following non-mandatory recommendations are provided. They were extracted from "Prudent Practices for Handling Hazardous Chemicals in Laboratories" (referred to below as "Prudent Practices"), which was published in 1981 by the National Research Council and is available from the National Academy Press, 2101 Constitution Ave., NW., Washington DC 20418.

"Prudent Practices" is cited because of its wide distribution and acceptance and because of its preparation by members of the laboratory community through the sponsorship of the National Research Council. However, none of the recommendations given here will modify any requirements of the laboratory standard. This Appendix merely presents pertinent recommendations from "Prudent Practices", organized into a form convenient for quick reference during operation of a laboratory facility and during development and application of a Chemical Hygiene Plan. Users of this appendix should consult "Prudent Practices" for a more extended presentation and justification for each recommendation.

"Prudent Practices" deals with both safety and chemical hazards while the laboratory standard is concerned primarily with chemical hazards. Therefore, only those recommendations directed primarily toward control of toxic exposures are cited in this appendix, with the term "chemical hygiene" being substituted for the word "safety". However, since conditions producing or threatening physical injury often pose toxic risks as well, page references concerning major categories of safety hazards in the laboratory are given in section F.

The recommendations from "Prudent Practices" have been paraphrased, combined, or otherwise reorganized, and headings have been added. However, their sense has not been changed.

In this appendix, those recommendations directed primarily at administrators and supervisors are given in sections A-D. Those recommendations of primary concern to employees who are actually handling laboratory chemicals are given in section E. (Reference to page numbers in "Prudent Practices" are given in parentheses.)

A. General Principles for Work with Laboratory Chemicals

In addition to the more detailed recommendations listed below in sections B-E, "Prudent Practices" expresses certain general principles, including the following:

1. It is prudent to minimize all chemical exposures. Because few laboratory chemicals are without hazards, general precautions for handling all laboratory chemicals should be adopted, rather than specific guidelines for particular chemicals (2, 10). Skin contact with chemicals should be avoided as a cardinal rule (198).

2. Avoid underestimation of risk. Even for substances of no known significant hazard, exposure should be minimized; for work with substances which present special hazards, special precautions should be taken (10, 37, 38). One should assume that any mixture will be more toxic than its most toxic component (30, 103) and that all substances of unknown toxicity are toxic (3, 34).

3. Provide adequate ventilation. The best way to prevent exposure to airborne substances is to prevent their escape into the working atmosphere by use of hoods and other ventilation devices (32, 198).

4. Institute a chemical hygiene program. A mandatory chemical hygiene program designed to minimize exposures is needed; it should be a regular, continuing effort, not merely a standby or short-term activity (6, 11). Its recommendations should be followed in academic teaching laboratories as well as by full-time laboratory workers (13).

5. Observe the PELs, TLVs. The Permissible Exposure Limits of OSHA and the Threshold Limit Values of the American Conference of Governmental Industrial Hygienists should not be exceeded (13).

B. Chemical Hygiene Responsibilities

Responsibility for chemical hygiene rests at all levels (6, 11, 21) including the:

1. Chief executive officer, who has ultimate responsibility for chemical hygiene within the institution and must, with other administrators, provide continuing support for institutional chemical hygiene (7, 11).

2. Supervisor of the department or other administrative unit, who is responsible for chemical hygiene in that unit (7).

3. Chemical hygiene officer(s), whose appointment is essential (7) and who must:

(a) Work with administrators and other employees to develop and implement appropriate chemical hygiene policies and practices (7);

(b) Monitor procurement, use, and disposal of chemicals used in the lab (8);

(c) See that appropriate audits are maintained (8);

(d) Help project directors develop precautions and adequate facilities (10);

(e) Know the current legal requirements concerning regulated substances (50); and

(f) Seek ways to improve the chemical hygiene program (8, 11).

4. Laboratory supervisor, who has overall responsibility for chemical hygiene in the laboratory (21) including responsibility to:

(a) Ensure that workers know and follow the chemical hygiene rules, that protective equipment is available and in working order, and that appropriate training has been provided (21, 22);

(b) Provide regular, formal chemical hygiene and housekeeping inspections including routine inspections of emergency equipment (21, 171);

(c) Know the current legal requirements concerning regulated substances (50, 231);

(d) Determine the required levels of protective apparel and equipment (156, 160, 162); and

(e) Ensure that facilities and training for use of any material being ordered are adequate (215).

5. Project director or director of other specific operation, who has primary responsibility for chemical hygiene procedures for that operation (7).

6. Laboratory worker, who is responsible for:

(a) Planning and conducting each operation in accordance with the institutional chemical hygiene procedures (7, 21, 22, 230); and

(b) Developing good personal chemical hygiene habits (22).

C. The Laboratory Facility

1. Design. The laboratory facility should have:

(a) An appropriate general ventilation system (see C4 below) with air intakes and exhausts located so as to avoid intake of contaminated air (194);

(b) Adequate, well-ventilated stockrooms/storerooms (218, 219);

(c) Laboratory hoods and sinks (12, 162);

(d) Other safety equipment including eyewash fountains and drench showers (162, 169); and

(e) Arrangements for waste disposal (12, 240).

2. Maintenance. Chemical-hygiene-related equipment (hoods, incinerator, etc.) should undergo continuing appraisal and be modified if inadequate (11, 12).

3. Usage. The work conducted (10) and its scale (12) must be appropriate to the physical facilities available and, especially, to the quality of ventilation (13).

4. Ventilation -- (a) General laboratory ventilation. This system should: Provide a source of air for breathing and for input to local ventilation devices (199); it should not be relied on for protection from toxic substances released into the laboratory (198); ensure that laboratory air is continually replaced, preventing increase of air concentrations of toxic substances during the working day (194); direct air flow into the laboratory from non-laboratory areas and out to the exterior of the building (194).

(b) Hoods. A laboratory hood with 2.5 linear feet of hood space per person should be provided for every 2 workers if they spend most of their time working with chemicals (199); each hood should have a continuous monitoring device to allow convenient confirmation of adequate hood performance before use (200, 209). If this is not possible, work with substances of unknown toxicity should be avoided (13) or other types of local ventilation devices should be provided (199). See pp. 201-206 for a discussion of hood design, construction, and evaluation.

(c) Other local ventilation devices. Ventilated storage cabinets, canopy hoods, snorkels, etc. should be provided as needed (199). Each canopy hood and snorkel should have a separate exhaust duct (207).

(d) Special ventilation areas. Exhaust air from glove boxes and isolation rooms should be passed through scrubbers or other treatment before release into the regular exhaust system (208). Cold rooms and warm rooms should have provisions for rapid escape and for escape in the event of electrical failure (209).

(e) Modifications. Any alteration of the ventilation system should be made only if thorough testing indicates that worker protection from airborne toxic substances will continue to be adequate (12, 193, 204).

(f) Performance. Rate: 4-12 room air changes/hour is normally adequate general ventilation if local exhaust systems such as hoods are used as the primary method of control (194).

(g) Quality. General air flow should not be turbulent and should be relatively uniform throughout the laboratory, with no high velocity or static areas (194, 195); airflow into and within the hood should not be excessively turbulent (200); hood face velocity should be adequate (typically 60-100 lfm) (200, 204).

(h) Evaluation. Quality and quantity of ventilation should be evaluated on installation (202), regularly monitored (at least every 3 months) (6, 12, 14, 195), and reevaluated whenever a change in local ventilation devices is made (12, 195, 207). See pp. 195-198 for methods of evaluation and for calculation of estimated airborne contaminant concentrations.

D. Components of the Chemical Hygiene Plan

1. Basic Rules and Procedures (Recommendations for these are given in section E, below)

2. Chemical Procurement, Distribution, and Storage

(a) Procurement. Before a substance is received, information on proper handling, storage, and disposal should be known to those who will be involved (215, 216). No container should be accepted without an adequate identifying label (216). Preferably, all substances should be received in a central location (216).

(b) Stockrooms/storerooms. Toxic substances should be segregated in a well-identified area with local exhaust ventilation (221). Chemicals which are highly toxic (227) or other chemicals whose containers have been opened should be in unbreakable secondary containers (219). Stored chemicals should be examined periodically (at least annually) for replacement, deterioration, and container integrity (218-19).

Stockrooms/storerooms should not be used as preparation or repackaging areas, should be open during normal working hours, and should be controlled by one person (219).

(c) Distribution. When chemicals are hand carried, the container should be placed in an outside container or bucket. Freight-only elevators should be used if possible (223).

(d) Laboratory storage. Amounts permitted should be as small as practical. Storage on bench tops and in hoods is inadvisable. Exposure to heat or direct sunlight should be avoided. Periodic inventories should be conducted, with unneeded items being discarded or returned to the storeroom/stockroom (225-6, 229).

3. Environmental Monitoring

Regular instrumental monitoring of airborne concentrations is not usually justified or practical in laboratories but may be appropriate when testing or redesigning hoods or other ventilation devices (12) or when a highly toxic substance is stored or used regularly (e.g., 3 times/week) (13).

4. Housekeeping, Maintenance, and Inspections

(a) Cleaning. Floors should be cleaned regularly (24).

(b) Inspections. Formal housekeeping and chemical hygiene inspections should be held at least quarterly (6, 21) for units which have frequent personnel changes and semiannually for others; informal inspections should be continual (21).

(c) Maintenance. Eye wash fountains should be inspected at intervals of not less than 3 months (6). Respirators for routine use should be inspected periodically by the laboratory supervisor (169). Safety showers should be tested routinely (169). Other safety equipment should be inspected regularly. (e.g., every 3-6 months) (6, 24, 171). Procedures to prevent restarting of out-of-service equipment should be established (25).

(d) Passageways. Stairways and hallways should not be used as storage areas (24). Access to exits, emergency equipment, and utility controls should never be blocked (24).

5. Medical Program

(a) Compliance with regulations. Regular medical surveillance should be established to the extent required by regulations (12).

(b) Routine surveillance. Anyone whose work involves regular and frequent handling of toxicologically significant quantities of a chemical should consult a qualified physician to determine on an individual basis whether a regular schedule of medical surveillance is desirable (11, 50).

(c) First aid. Personnel trained in first aid should be available during working hours and an emergency room with medical personnel should be nearby (173). See pp. 176-178 for description of some emergency first aid procedures.

6. Protective Apparel and Equipment

These should include for each laboratory:

(a) Protective apparel compatible with the required degree of protection for substances being handled (158-161);

(b) An easily accessible drench-type safety shower (162, 169);

(c) An eyewash fountain (162);

(d) A fire extinguisher (162-164);

(e) Respiratory protection (164-9), fire alarm and telephone for emergency use (162) should be available nearby; and

(f) Other items designated by the laboratory supervisor (156, 160).

7. Records

(a) Accident records should be written and retained (174).

(b) Chemical Hygiene Plan records should document that the facilities and precautions were compatible with current knowledge and regulations (7).

(c) Inventory and usage records for high-risk substances should be kept as specified in sections E3e below.

(d) Medical records should be retained by the institution in accordance with the requirements of state and federal regulations (12).

8. Signs and Labels

Prominent signs and labels of the following types should be posted:

(a) Emergency telephone numbers of emergency personnel/facilities, supervisors, and laboratory workers (28);

(b) Identity labels, showing contents of containers (including waste receptacles) and associated hazards (27, 48);

(c) Location signs for safety showers, eyewash stations, other safety and first aid equipment, exits (27) and areas where food and beverage consumption and storage are permitted (24); and

(d) Warnings at areas or equipment where special or unusual hazards exist (27).

9. Spills and Accidents

(a) A written emergency plan should be established and communicated to all personnel; it should include procedures for ventilation failure (200), evacuation, medical care, reporting, and drills (172).

(b) There should be an alarm system to alert people in all parts of the facility including isolation areas such as cold rooms (172).

(c) A spill control policy should be developed and should include consideration of prevention, containment, cleanup, and reporting (175).

(d) All accidents or near accidents should be carefully analyzed with the results distributed to all who might benefit (8, 28).

10. Information and Training Program

(a) Aim: To assure that all individuals at risk are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs (5, 15).

(b) Emergency and Personal Protection Training: Every laboratory worker should know the location and proper use of available protective apparel and equipment (154, 169).

Some of the full-time personnel of the laboratory should be trained in the proper use of emergency equipment and procedures (6).

Such training as well as first aid instruction should be available to (154) and encouraged for (176) everyone who might need it.

(c) Receiving and stockroom/storeroom personnel should know about hazards, handling equipment, protective apparel, and relevant regulations (217).

(d) Frequency of Training: The training and education program should be a regular, continuing activity -- not simply an annual presentation (15).

(e) Literature/Consultation: Literature and consulting advice concerning chemical hygiene should be readily available to laboratory personnel, who should be encouraged to use these information resources (14).

11. Waste Disposal Program.

(a) Aim: To assure that minimal harm to people, other organisms, and the environment will result from the disposal of waste laboratory chemicals (5).

(b) Content (14, 232, 233, 240): The waste disposal program should specify how waste is to be collected, segregated, stored, and transported and include consideration of what materials can be incinerated. Transport from the institution must be in accordance with DOT regulations (244).

(c) Discarding Chemical Stocks: Unlabeled containers of chemicals and solutions should undergo prompt disposal; if partially used, they should not be opened (24, 27).

Before a worker's employment in the laboratory ends, chemicals for which that person was responsible should be discarded or returned to storage (226).

(d) Frequency of Disposal: Waste should be removed from laboratories to a central waste storage area at least once per week and from the central waste storage area at regular intervals (14).

(e) Method of Disposal: Incineration in an environmentally acceptable manner is the most practical disposal method for combustible laboratory waste (14, 238, 241).

Indiscriminate disposal by pouring waste chemicals down the drain (14, 231, 242) or adding them to mixed refuse for landfill burial is unacceptable (14).

Hoods should not be used as a means of disposal for volatile chemicals (40, 200).

Disposal by recycling (233, 243) or chemical decontamination (40, 230) should be used when possible.

E. Basic Rules and Procedures for Working with Chemicals

The Chemical Hygiene Plan should require that laboratory workers know and follow its rules and procedures. In addition to the procedures of the sub programs mentioned above, these should include the rules listed below.

1. General Rules

The following should be used for essentially all laboratory work with chemicals:

(a) Accidents and spills -- Eye Contact: Promptly flush eyes with water for a prolonged period (15 minutes) and seek medical attention (33, 172).

Ingestion: Encourage the victim to drink large amounts of water (178).

Skin Contact: Promptly flush the affected area with water (33, 172, 178) and remove any contaminated clothing (172, 178). If symptoms persist after washing, seek medical attention (33).

Clean-up. Promptly clean up spills, using appropriate protective apparel and equipment and proper disposal (24 33). See pp. 233-237 for specific clean-up recommendations.

(b) Avoidance of "routine" exposure: Develop and encourage safe habits (23); avoid unnecessary exposure to chemicals by any route (23);

Do not smell or taste chemicals (32). Vent apparatus which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices (199).

Inspect gloves (157) and test glove boxes (208) before use.

Do not allow release of toxic substances in cold rooms and warm rooms, since these have contained recirculated atmospheres (209).

(c) Choice of chemicals: Use only those chemicals for which the quality of the available ventilation system is appropriate (13).

(d) Eating, smoking, etc.: Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present (22, 24, 32, 40); wash hands before conducting these activities (23, 24).

Avoid storage, handling or consumption of food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations (23, 24, 226).

(e) Equipment and glassware: Handle and store laboratory glassware with care to avoid damage; do not use damaged glassware (25). Use extra care with Dewar flasks and other evacuated glass apparatus; shield or wrap them to contain chemicals and fragments should implosion occur (25). Use equipment only for its designed purpose (23, 26).

(f) Exiting: Wash areas of exposed skin well before leaving the laboratory (23).

(g) Horseplay: Avoid practical jokes or other behavior which might confuse, startle or distract another worker (23).

(h) Mouth suction: Do not use mouth suction for pipeting or starting a siphon (23, 32).

(i) Personal apparel: Confine long hair and loose clothing (23, 158). Wear shoes at all times in the laboratory but do not wear sandals, perforated shoes, or sneakers (158).

(j) Personal housekeeping: Keep the work area clean and uncluttered, with chemicals and equipment being properly labeled and stored; clean up the work area on completion of an operation or at the end of each day (24).

(k) Personal protection: Assure that appropriate eye protection (154-156) is worn by all persons, including visitors, where chemicals are stored or handled (22, 23, 33, 154).

Wear appropriate gloves when the potential for contact with toxic materials exists (157); inspect the gloves before each use, wash them before removal, and replace them periodically (157). (A table of resistance to chemicals of common glove materials is given p. 159).

Use appropriate (164-168) respiratory equipment when air contaminant concentrations are not sufficiently restricted by engineering controls (164-5), inspecting the respirator before use (169).

Use any other protective and emergency apparel and equipment as appropriate (22, 157-162).

Avoid use of contact lenses in the laboratory unless necessary; if they are used, inform supervisor so special precautions can be taken (155).

Remove laboratory coats immediately on significant contamination (161).

(l) Planning: Seek information and advice about hazards (7), plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation (22, 23).

(m) Unattended operations: Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substances in the event of failure of a utility service (such as cooling water) to an unattended operation (27, 128).

(n) Use of hood: Use the hood for operations which might result in release of toxic chemical vapors or dust (198-9).

As a rule of thumb, use a hood or other local ventilation device when working with any appreciably volatile substance with a TLV of less than 50 ppm (13).

Confirm adequate hood performance before use; keep hood closed at all times except when adjustments within the hood are being made (200); keep materials stored in hoods to a minimum and do not allow them to block vents or air flow (200).

Leave the hood "on" when it is not in active use if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off" (200).

(o) Vigilance: Be alert to unsafe conditions and see that they are corrected when detected (22).

(p) Waste disposal: Assure that the plan for each laboratory operation includes plans and training for waste disposal (230).

Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the Chemical Hygiene Plan (22, 24).

Do not discharge to the sewer concentrated acids or bases (231); highly toxic, malodorous, or lachrymatory substances (231); or any substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow (242).

(q) Working alone: Avoid working alone in a building; do not work alone in a laboratory if the procedures being conducted are hazardous (28).

2. Working with Allergens and Embryotoxins

(a) Allergens (examples: diazomethane, isocyanates, bichromates): Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity (35).

(b) Embryotoxins (34-5) (examples: organomercurials, lead compounds, formamide): If you are a woman of childbearing age, handle these substances only in a hood whose satisfactory performance has been confirmed, using appropriate protective apparel (especially gloves) to prevent skin contact.

Review each use of these materials with the research supervisor and review continuing uses annually or whenever a procedural change is made.

Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container.

Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.

3. Work with Chemicals of Moderate Chronic or High Acute Toxicity

Examples: diisopropylflurophosphate (41), hydrofluoric acid (43), hydrogen cyanide (45).

Supplemental rules to be followed in addition to those mentioned above (Procedure B of "Prudent Practices", pp. 39-41):

(a) Aim: To minimize exposure to these toxic substances by any route using all reasonable precautions (39).

(b) Applicability: These precautions are appropriate for substances with moderate chronic or high acute toxicity used in significant quantities (39).

(c) Location: Use and store these substances only in areas of restricted access with special warning signs (40, 229).

Always use a hood (previously evaluated to confirm adequate performance with a face velocity of at least 60 linear feet per minute) (40) or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance (39); trap released vapors to prevent their discharge with the hood exhaust (40).

(d) Personal protection: Always avoid skin contact by use of gloves and long sleeves (and other protective apparel as appropriate) (39). Always wash hands and arms immediately after working with these materials (40).

(e) Records: Maintain records of the amounts of these materials on hand, amounts used, and the names of the workers involved (40, 229).

(f) Prevention of spills and accidents: Be prepared for accidents and spills (41).

Assure that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity (39).

Store breakable containers of these substances in chemically resistant trays; also work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper (40).

If a major spill occurs outside the hood, evacuate the area; assure that cleanup personnel wear suitable protective apparel and equipment (41).

(g) Waste: Thoroughly decontaminate or incinerate contaminated clothing or shoes (41). If possible, chemically decontaminate by chemical conversion (40).

Store contaminated waste in closed, suitably labeled, impervious containers (for liquids, in glass or plastic bottles half-filled with vermiculite) (40).

4. Work with Chemicals of High Chronic Toxicity

(Examples: dimethylmercury and nickel carbonyl (48), benzo-a-pyrene (51), N-nitrosodiethylamine (54), other human carcinogens or substances with high carcinogenic potency in animals (38).)

Further supplemental rules to be followed, in addition to all these mentioned above, for work with substances of known high chronic toxicity (in quantities above a few milligrams to a few grams, depending on the substance) (47). (Procedure A of "Prudent Practices" pp. 47-50).

(a) Access: Conduct all transfers and work with these substances in a "controlled area": a restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances, for which all people with access are aware of the substances being used and necessary precautions (48).

(b) Approvals: Prepare a plan for use and disposal of these materials and obtain the approval of the laboratory supervisor (48).

(c) Non-contamination/Decontamination: Protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood (49). Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area (49, 50).

Decontaminate the controlled area before normal work is resumed there (50).

(d) Exiting: On leaving a controlled area, remove any protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck (49).

(e) Housekeeping: Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance was a dry powder (50).

(f) Medical surveillance: If using toxicologically significant quantities of such a substance on a regular basis (e.g., 3 times per week), consult a qualified physician concerning desirability of regular medical surveillance (50).

(g) Records: Keep accurate records of the amounts of these substances stored (229) and used, the dates of use, and names of users (48).

(h) Signs and labels: Assure that the controlled area is conspicuously marked with warning and restricted access signs (49) and that all containers of these substances are appropriately labeled with identity and warning labels (48).

(i) Spills: Assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available (233-4).

(j) Storage: Store containers of these chemicals only in a ventilated, limited access (48, 227, 229) area in appropriately labeled, unbreakable, chemically resistant, secondary containers (48, 229).

(k) Glove boxes: For a negative pressure glove box, ventilation rate must be at least 2 volume changes/hour and pressure at least 0.5 inches of water (48). For a positive pressure glove box, thoroughly check for leaks before each use (49). In either case, trap the exit gases or filter them through a HEPA filter and then release them into the hood (49).

(l) Waste: Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred from the controlled area in a secondary container under the supervision of authorized personnel (49, 50, 233).

5. Animal Work with Chemicals of High Chronic Toxicity

(a) Access: For large scale studies, special facilities with restricted access are preferable (56).

(b) Administration of the toxic substance: When possible, administer the substance by injection or gavage instead of in the diet. If administration is in the diet, use a caging system under negative pressure or under laminar air flow directed toward HEPA filters (56).

(c) Aerosol suppression: Devise procedures which minimize formation and dispersal of contaminated aerosols, including those from food, urine, and feces (e.g., use HEPA filtered vacuum equipment for cleaning, moisten contaminated bedding before removal from the cage, mix diets in closed containers in a hood) (55, 56).

(d) Personal protection: When working in the animal room, wear plastic or rubber gloves, fully buttoned laboratory coat or jumpsuit and, if needed because of incomplete suppression of aerosols, other apparel and equipment (shoe and head coverings, respirator) (56).

(e) Waste disposal: Dispose of contaminated animal tissues and excreta by incineration if the available incinerator can convert the contaminant to non-toxic products (238); otherwise, package the waste appropriately for burial in an EPA-approved site (239).

F. Safety Recommendations

The above recommendations from "Prudent Practices" do not include those which are directed primarily toward prevention of physical injury rather than toxic exposure. However, failure of precautions against injury will often have the secondary effect of causing toxic exposures.

Therefore, we list below page references for recommendations concerning some of the major categories of safety hazards which also have implications for chemical hygiene:

1. Corrosive agents: (35-6)

2. Electrically powered laboratory apparatus: (179-92)

3. Fires, explosions: (26, 57-74, 162-4, 174-5, 219-20, 226-7)

4. Low temperature procedures: (26, 88)

5. Pressurized and vacuum operations (including use of compressed gas cylinders): (27, 75-101)

G. Material Safety Data Sheets

Material safety data sheets are presented in "Prudent Practices" for the chemicals listed below. (Asterisks denote that comprehensive material safety data sheets are provided).

*Acetyl peroxide (105)

*Acrolein (106)

*Acrylonilrile (107)

Ammonia (anhydrous) (91)

*Aniline (109)

*Benzene (110)

*Benzo[a]pyrene (112)

*Bis(chloromethyl) ether (113)

Boron trichloride (91)

Boron trifluoride (92)

Bromine (114)

*Tert-butyl hydroperoxide (148)

*Carbon disulfide (116)

Carbon monoxide (92)

*Carbon tetrachloride (118)

*Chlorine (119)

Chlorine trifluoride (94)

*Chloroform (121)

Chloromethane (93)

*Diethyl ether (122)

Diisopropyl fluorophosphate (41)

*Dimethylformamide (123)

*Dimethyl sulfate (125)

*Dioxane (126)

*Ethylene dibromide (128)

*Fluorine (95)

*Formaldehyde (130)

*Hydrazine and salts (132)

Hydrofluoric acid (43)

Hydrogen bromide (98)

Hydrogen chloride (98)

*Hydrogen cyanide (133)

*Hydrogen sulfide (135)

Mercury and compounds (52)

*Methanol (137)

*Morpholine (138)

*Nickel carbonyl (99)

*Nitrobenzene (139)

Nitrogen dioxide (100)

N-nitrosodiethylamine (54)

*Peracetic acid (141)

*Phenol (142)

*Phosgene (143)

*Pyridine (144)

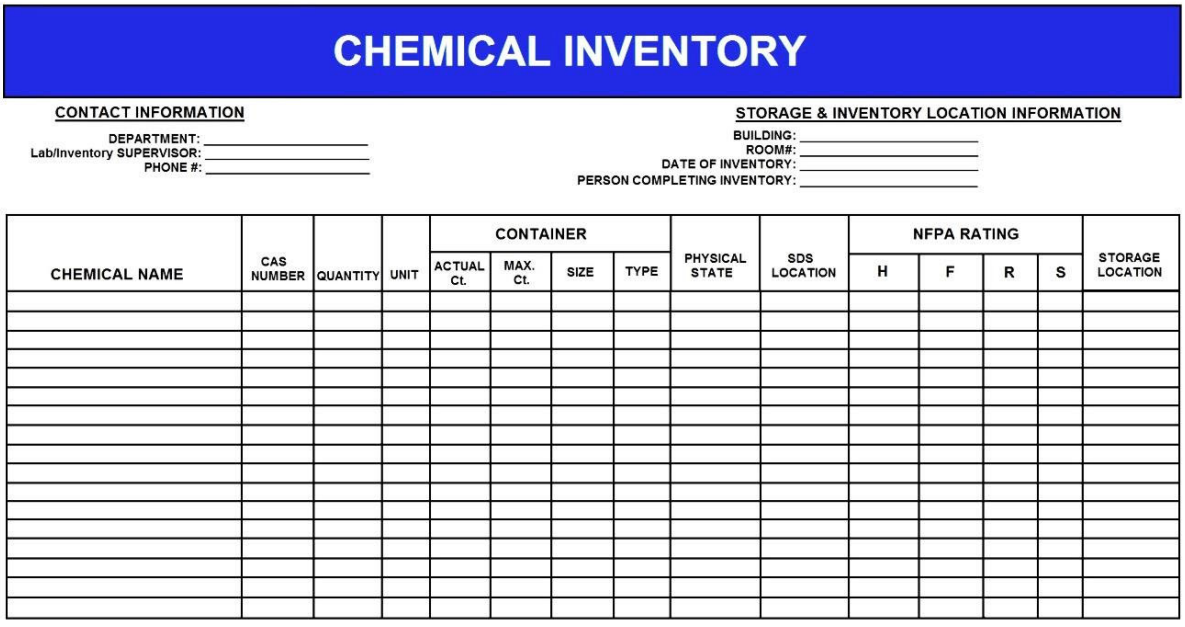
*Sodium azide (145)

*Sodium cyanide (147)

Sulfur dioxide (101)

*Trichloroethylene (149)

*Vinyl chloride (150)



CHEMICAL INVENTORY

CONTACT INFORMATION

DEPARTMENT: _____
Lab/Inventory SUPERVISOR: _____
PHONE #: _____

STORAGE & INVENTORY LOCATION INFORMATION

BUILDING: _____
ROOM#: _____
DATE OF INVENTORY: _____
PERSON COMPLETING INVENTORY: _____

CHEMICAL NAME	CAS NUMBER	QUANTITY	UNIT	CONTAINER				PHYSICAL STATE	SDS LOCATION	NFPA RATING				STORAGE LOCATION
				ACTUAL Ct.	MAX. Ct.	SIZE	TYPE			H	F	R	S	

CHEMICAL INVENTORY WORKSHEET

APPENDIX B TO § 1910.1450 -- REFERENCES (NON-MANDATORY)

The following references are provided to assist the employer in the development of a Chemical Hygiene Plan. The materials listed below are offered as non-mandatory guidance. References listed here do not imply specific endorsement of a book, opinion, technique, policy or a specific solution for a safety or health problem. Other references not listed here may better meet the needs of a specific laboratory. (a) Materials for the development of the Chemical Hygiene Plan:

1. American Chemical Society, Safety in Academic Chemistry Laboratories, 4th edition, 1985.

2. Fawcett, H.H. and W. S. Wood, Safety and Accident Prevention in Chemical Operations, 2nd edition, Wiley-Interscience, New York, 1982.

3. Flury, Patricia A., Environmental Health and Safety in the Hospital Laboratory, Charles C. Thomas Publisher, Springfield IL, 1978.

4. Green, Michael E. and Turk, Amos, Safety in Working with Chemicals, Macmillan Publishing Co., NY, 1978.

5. Kaufman, James A., Laboratory Safety Guidelines, Dow Chemical Co., Box 1713, Midland, MI 48640, 1977.

6. National Institutes of Health, NIH Guidelines for the Laboratory use of Chemical Carcinogens, NIH Pub. No. 81-2385, GPO, Washington, DC 20402, 1981.

7. National Research Council, Prudent Practices for Disposal of Chemicals from Laboratories, National Academy Press, Washington, DC, 1983.

8. National Research Council, Prudent Practices for Handling Hazardous Chemicals in Laboratories, National Academy Press, Washington, DC, 1981.

9. Renfrew, Malcolm, Ed., Safety in the Chemical Laboratory, Vol. IV, J. Chem. Ed., American Chemical Society, Easlon, PA, 1981.

10. Steere, Norman V., Ed., Safety in the Chemical Laboratory, J. Chem. Ed. American Chemical Society, Easlon, PA, 18042, Vol. I, 1967, Vol. II, 1971, Vol. III 1974.

11. Steere, Norman V., Handbook of Laboratory Safety, the Chemical Rubber Company Cleveland, OH, 1971.

12. Young, Jay A., Ed., Improving Safety in the Chemical Laboratory, John Wiley & Sons, Inc. New York, 1987.

(b) Hazardous Substances Information:

1. American Conference of Governmental Industrial Hygienists, Threshold Limit Values for Chemical Substances and Physical Agents in the Workroom Environment with Intended Changes, 6500 Glenway Avenue, Bldg. D-7 Cincinnati, OH 45211-4438 (latest edition).

2. Annual Report on Carcinogens, National Toxicology Program U.S. Department of Health and Human Services, Public Health Service, U.S. Government Printing Office, Washington, DC, (latest edition).

3. Best Company, Best Safety Directory, Vols. I and II, Oldwick, N.J., 1981.

4. Bretherick, L., Handbook of Reactive Chemical Hazards, 2nd edition, Butterworths, London, 1979.

5. Bretherick, L., Hazards in the Chemical Laboratory, 3rd edition, Royal Society of Chemistry, London, 1986.

6. Code of Federal Regulations, 29 CFR part 1910 subpart Z. U.S. Govt. Printing Office, Washington, DC 20402 (latest edition).

7. IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Man, World Health Organization Publications Center, 49 Sheridan Avenue, Albany, New York 12210 (latest editions).

8. NIOSH/OSHA Pocket Guide to Chemical Hazards. NIOSH Pub. No. 85-114, U.S. Government Printing Office, Washington, DC, 1985 (or latest edition).

9. Occupational Health Guidelines, NIOSH/OSHA NIOSH Pub. No. 81-123 U.S. Government Printing Office, Washington, DC, 1981.

10. Patty, F.A., Industrial Hygiene and Toxicology, John Wiley & Sons, Inc., New York, NY (Five Volumes).

11. Registry of Toxic Effects of Chemical Substances, U.S. Department of Health and Human Services, Public Health Service, Centers for Disease Control, National Institute for Occupational Safety and Health, Revised Annually, for sale from Superintendent of Documents U.S. Govt. Printing Office, Washington, DC 20402.

12. The Merck Index: An Encyclopedia of Chemicals and Drugs. Merck and Company Inc. Rahway, N.J., 1976 (or latest edition).

13. Sax, N.I. Dangerous Properties of Industrial Materials, 5th edition, Van Nostrand Reinhold, NY., 1979.

14. Sittig, Marshall, Handbook of Toxic and Hazardous Chemicals, Noyes Publications, Park Ridge, NJ, 1981.

(c) Information on Ventilation:

1. American Conference of Governmental Industrial Hygienists Industrial Ventilation (latest edition), 6500 Glenway Avenue, Bldg. D-7, Cincinnati, Ohio 45211-4438.

2. American National Standards Institute, Inc. American National Standards Fundamentals Governing the Design and Operation of Local Exhaust Systems ANSI Z 9.2-1979 American National Standards Institute, N.Y. 1979.

3. Imad, A.P. and Watson, C.L. Ventilation Index: An Easy Way to Decide about Hazardous Liquids, Professional Safety pp 15-18, April 1980.

4. National Fire Protection Association, Fire Protection for Laboratories Using Chemicals NFPA-45, 1982.

Safety Standard for Laboratories in Health Related Institutions, NFPA, 56c, 1980.

Fire Protection Guide on Hazardous Materials, 7th edition, 1978.

National Fire Protection Association, Batterymarch Park, Quincy, MA 02269.

5. Scientific Apparatus Makers Association (SAMA), Standard for Laboratory Fume Hoods, SAMA LF7-1980, 1101 16th Street, NW., Washington, DC 20036.

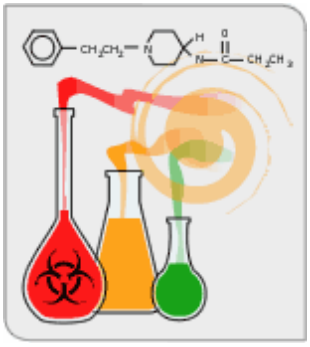
(d) Information on Availability of Referenced Material:

1. American National Standards Institute (ANSI), 1430 Broadway, New York, NY 10018.

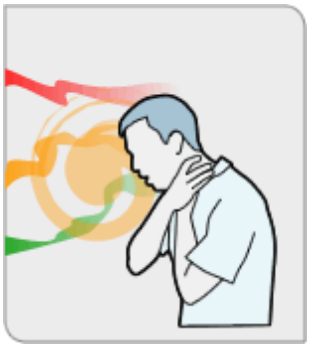
2. American Society for Testing and Materials (ASTM), 1916 Race Street, Philadelphia, PA 19103.


CHEMICAL
HYGIENE
PLAN
DANGER
SAFETY EDUCATION

Chemical Attack



1. A chemical attack is the deliberate release of a toxic gas, liquid or solid that can poison people and the environment.



2. Watch for signs such as many people suffering from watery eyes, twitching, choking, having trouble breathing or losing coordination.

3. Many sick or dead birds, fish or small animals are also cause for suspicion.

4. If you see signs of a chemical attack, quickly try to define the impacted area or where the chemical is coming from, if possible.

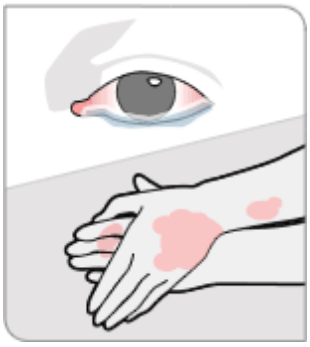
5. Take immediate action to get away from any sign of a chemical attack.

6. If the chemical is inside a building where you are, try to get out of the building without passing through the contaminated area, if possible.

7. Otherwise, it may be better to move as far away from where you suspect the chemical release is and "shelter-in-place."

8. If you are outside when you see signs of a chemical attack, you must quickly decide the fastest way to get away from the chemical threat.

9. Consider if you can get out of the area or if it would be better to go inside a building and follow your plan to "shelter-in-place."

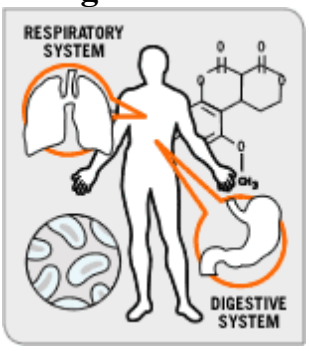


10. If your eyes are watering, your skin is stinging, you are having trouble breathing or you simply think you may have been exposed to a chemical, immediately strip and wash. Look for a hose, fountain, or any source of water.

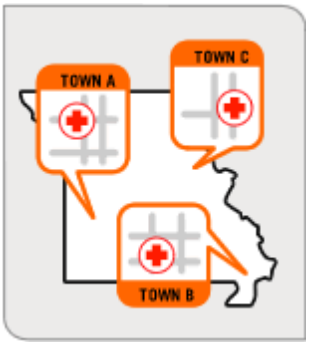
11. Wash with soap and water, if possible, but do not scrub the chemical into your skin.

12. Seek emergency medical attention.

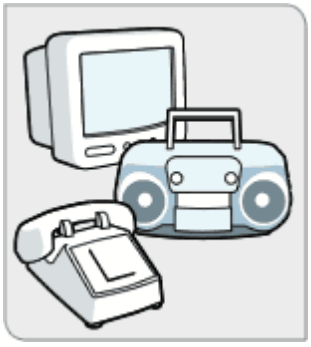
Biological Attack



1. A biological attack is the release of germs or other biological substances. Many agents must be inhaled, enter through a cut in the skin or be eaten to make you sick. Some biological agents can cause contagious diseases, others do not.



2. A biological attack may or may not be immediately obvious. While it is possible that you will see signs of a biological attack it is perhaps more likely that local health care workers will report a pattern of unusual illness.

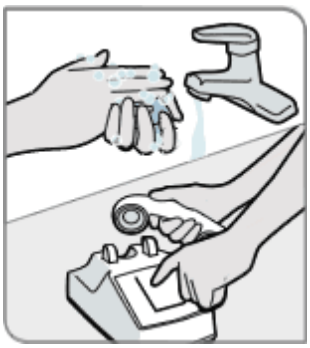


3. You will probably learn of the danger through an emergency radio or TV broadcast.

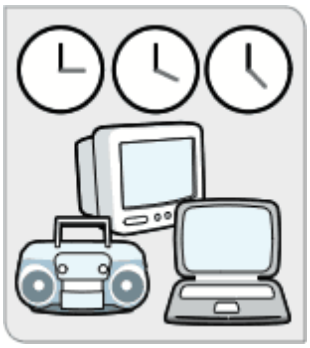
4. If you become aware of an unusual or suspicious release of an unknown substance nearby, it doesn't hurt to protect yourself.

5. Get away from the substance as quickly as possible.

6. Cover your mouth and nose with layers of fabric that can filter the air but still allow breathing.



7. Wash with soap and water and contact authorities.



8. In the event of a biological attack, public health officials may not immediately be able to provide information on what you should do. However, you should watch TV, listen to the radio, or check the Internet for official news as it becomes available.

9. At the time of a declared biological emergency be suspicious, but do not automatically assume that any illness is the result of the attack. Symptoms of many common illnesses may overlap. Use common sense, practice good hygiene and cleanliness to avoid spreading germs, and seek medical advice.

If there is an explosion...

1. Take shelter against your desk or a sturdy table.

2. Exit the building as quickly as possible.

3. Do not use elevators.

4. Check for fire and other hazards.

5. Take your emergency kit if time allows.

If there is fire...

1. Exit the building as quickly as possible.

2. Crawl low in smoke.

3. Use a wet cloth to cover your nose and mouth.

4. Use the back of your hand to feel the lower, middle, and upper parts of closed doors.

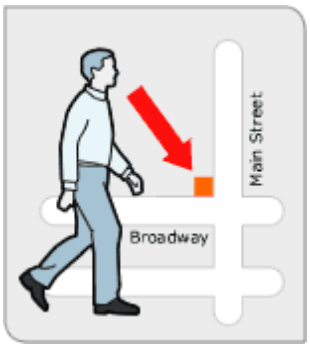
5. If the door is not hot, brace yourself against the door and open it slowly.

6. Do not open the door if it is hot. Look for another way out.

7. Use appropriate fire exits, not elevators.

8. If you catch fire, do not run!

9. Stop, Drop and Roll.



10. If you are at home, go to previously designated meeting place.

11. Account for your family members.

12. Do not go back into a burning building and carefully supervise small children.

If there is fire...

13. Call the fire department.

Nuclear Blast

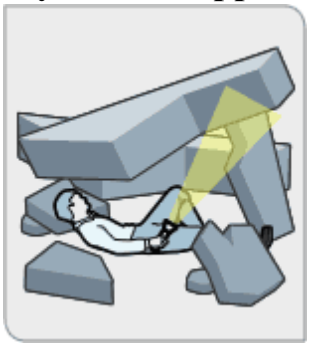
1. Take cover immediately, below ground if possible, though any shield or shelter will help protect you from the immediate effects of the blast and the pressure wave.
2. Consider if you can get out of the area;
3. Or if it would be better to go inside a building and follow your plan to "shelter-in-place".
4. In order to limit the amount of radiation you are exposed to, think about shielding, distance and time.

Shielding: If you have a thick shield between yourself and the radioactive materials more of the radiation will be absorbed, and you will be exposed to less.

Distance: The farther away from the blast and the fallout the lower your exposure.

Time: Minimize time spent exposed will also reduce your risk.

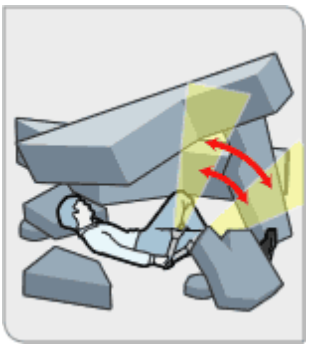
If you are trapped in debris...



1. If possible, use a flashlight to signal your location.

2. Avoid unnecessary movement so that you don't kick up dust.

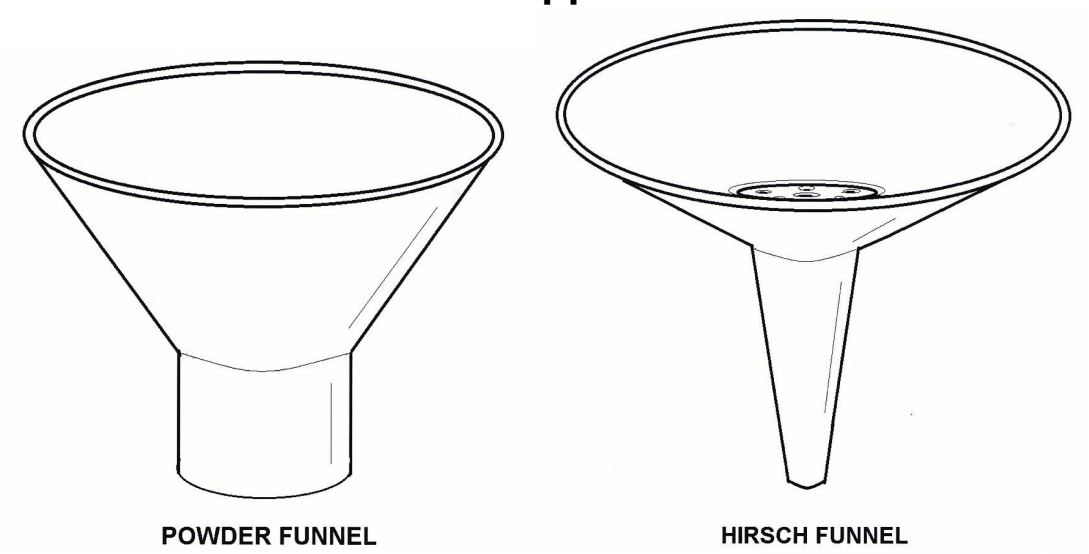
3. Cover your mouth and nose with anything you have on hand. Dense weave cotton material can create a good filter. Try to breathe through the material.



4. Tap on a pipe or wall so that rescuers can hear where you are.

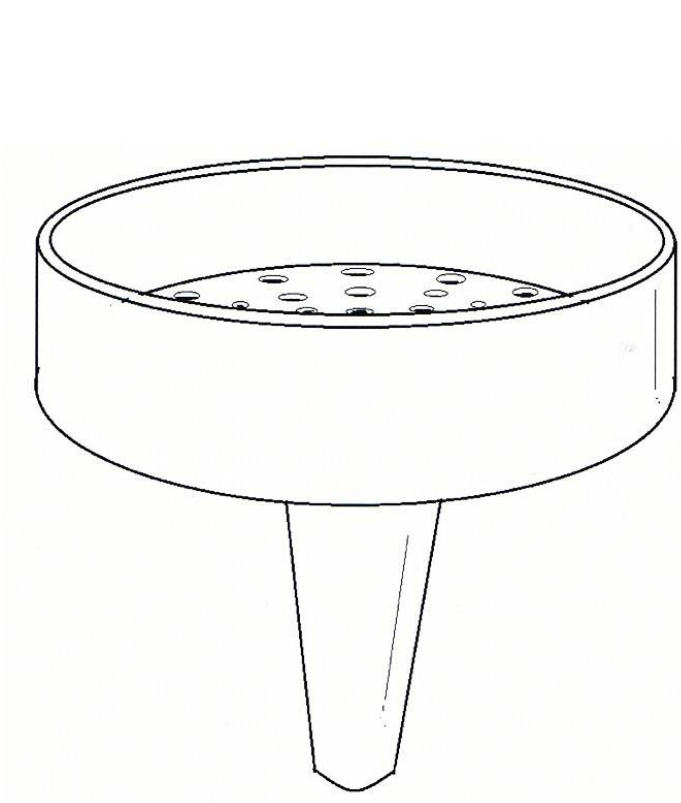
5. Use a whistle if one is available. Shout only as a last resort - shouting can cause a person to inhale dangerous amounts of dust.

Common Lab Glassware Appendix

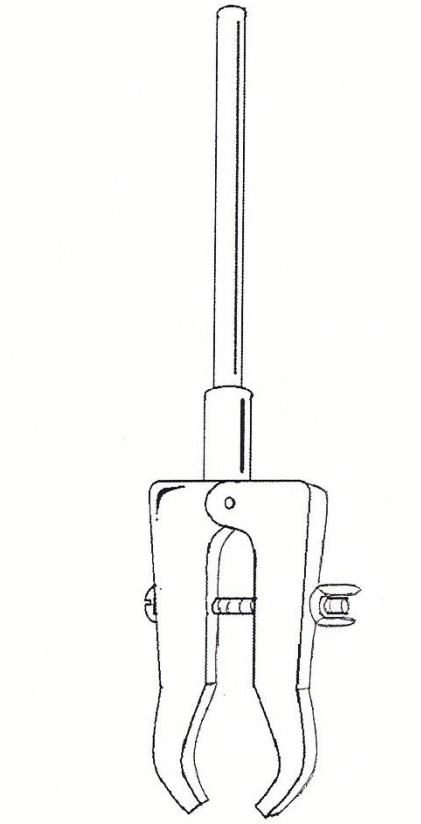


POWDER FUNNEL

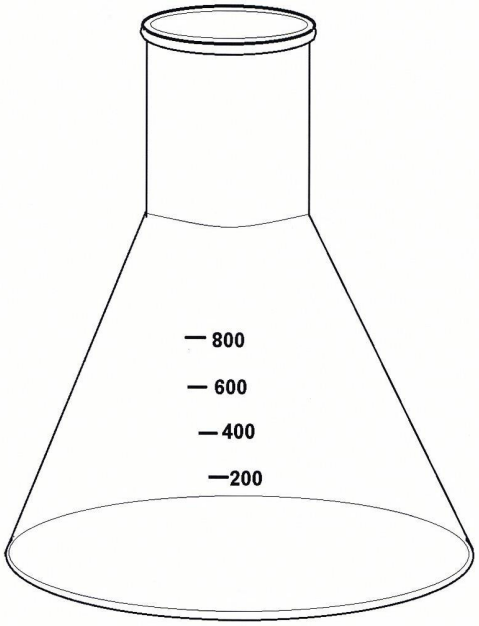
HIRSCH FUNNEL



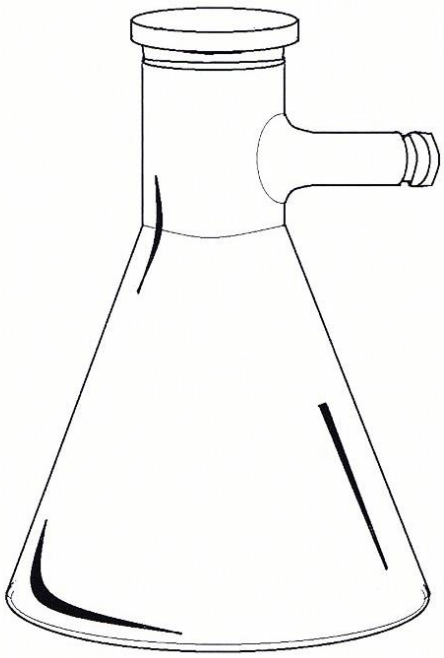
BÜCHNER FUNNEL



EXTENSION CLAMP

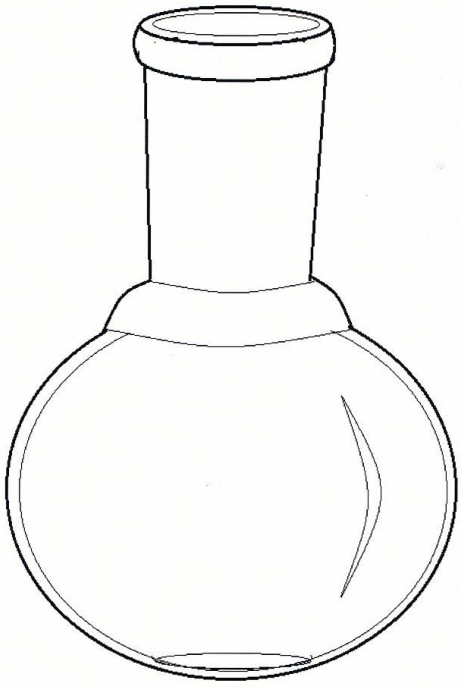


ERLENMEYER FLASK

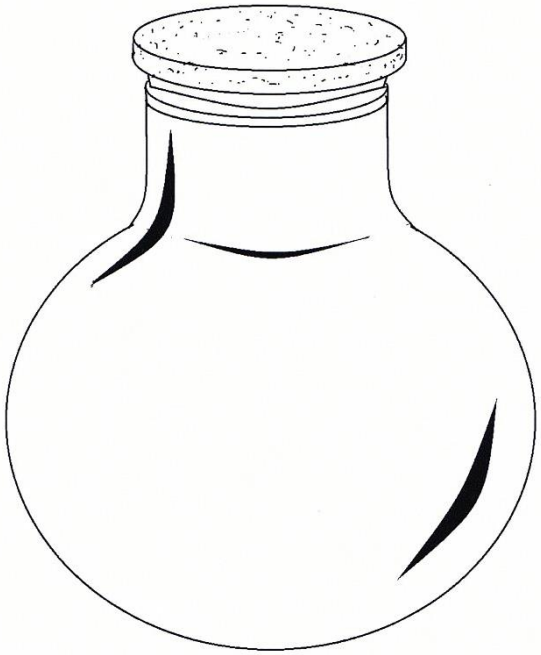


500 ml FILTER FLASK

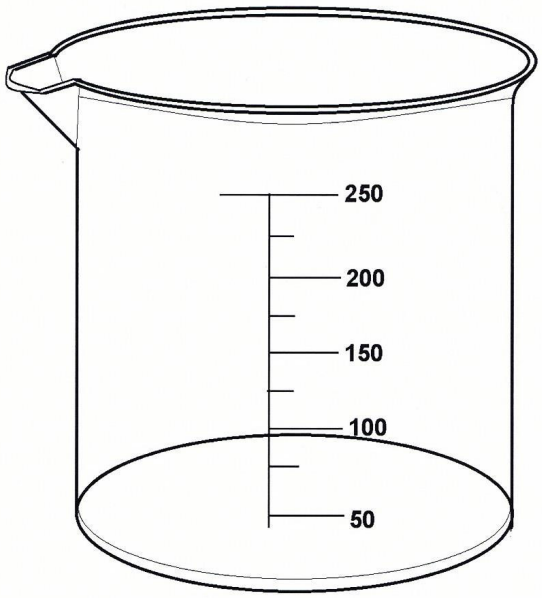
TWO-NECK
ROUND BOTTOM BOILING FLASK



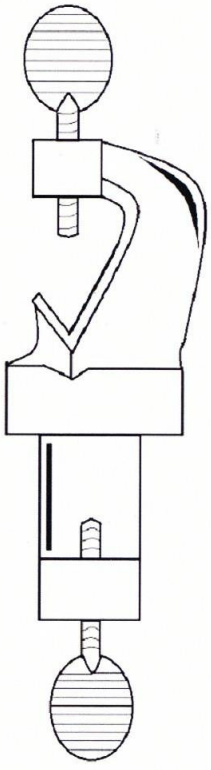
ROUND-BOTTOM
BOILING FLASK



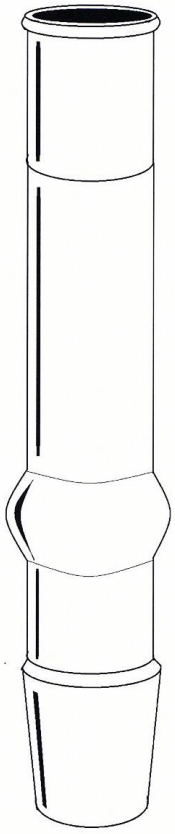
ROUND-BOTTOM
BOILING FLASK



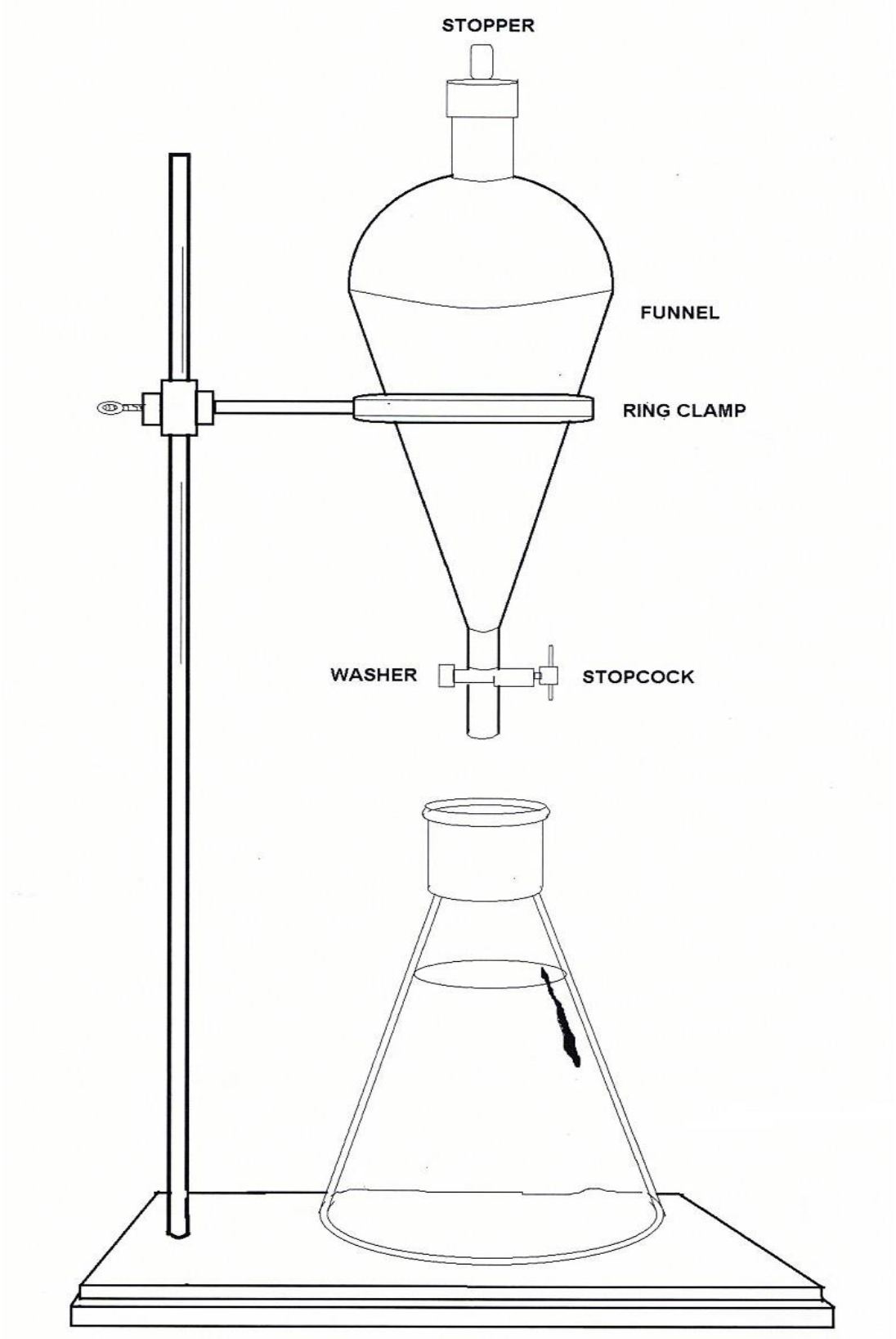
BEAKER



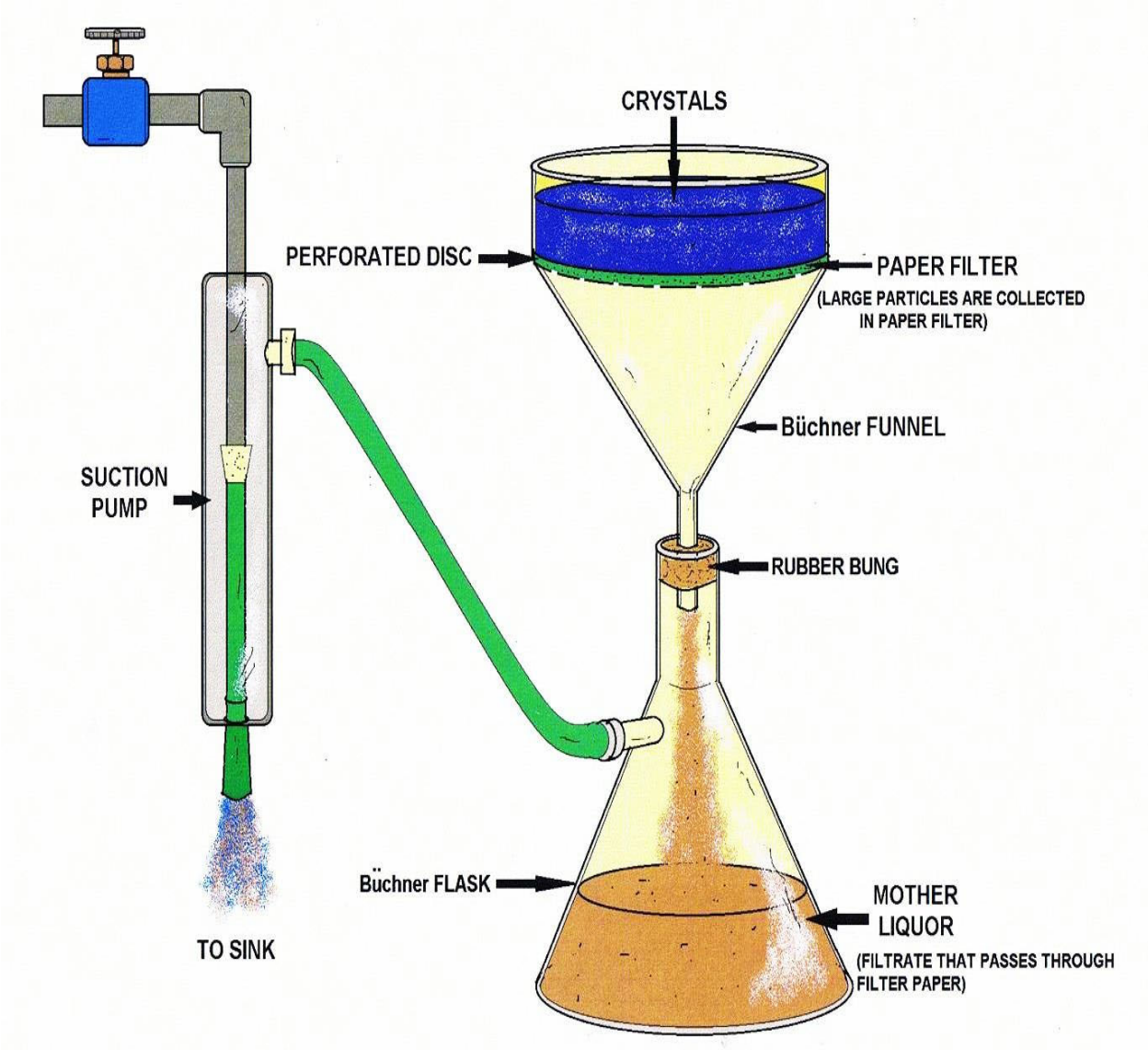
EXTENSION CLAMP FASTENER

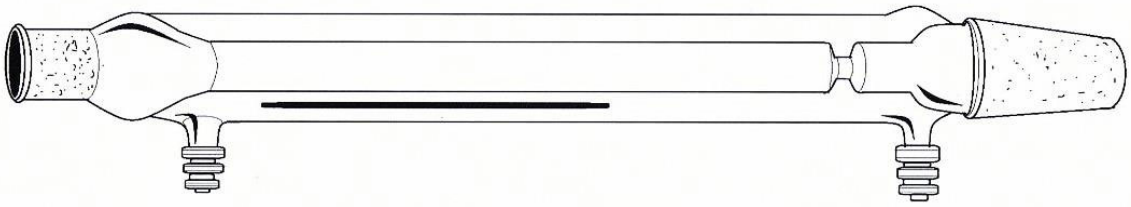


DRYING TUBE

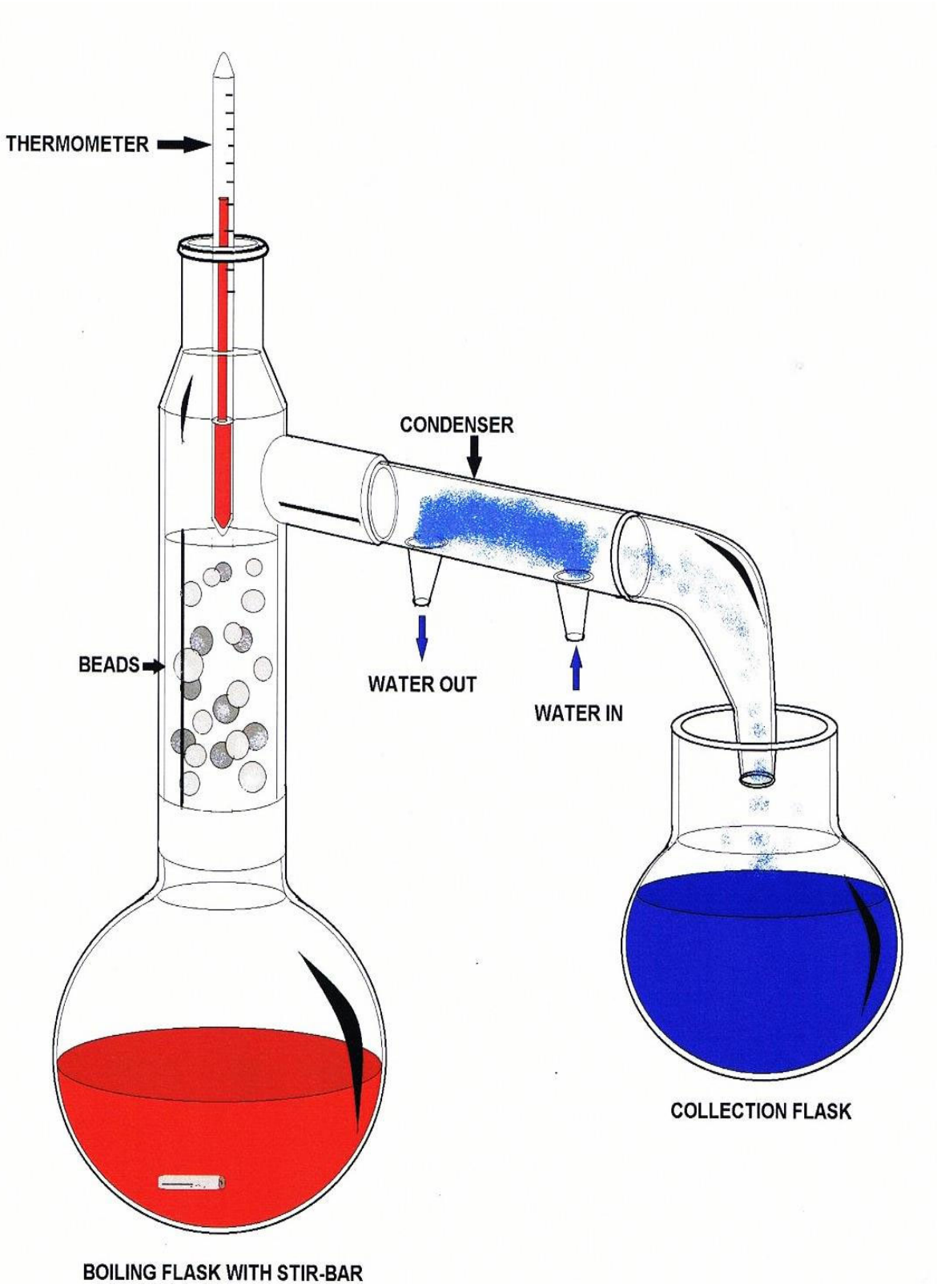


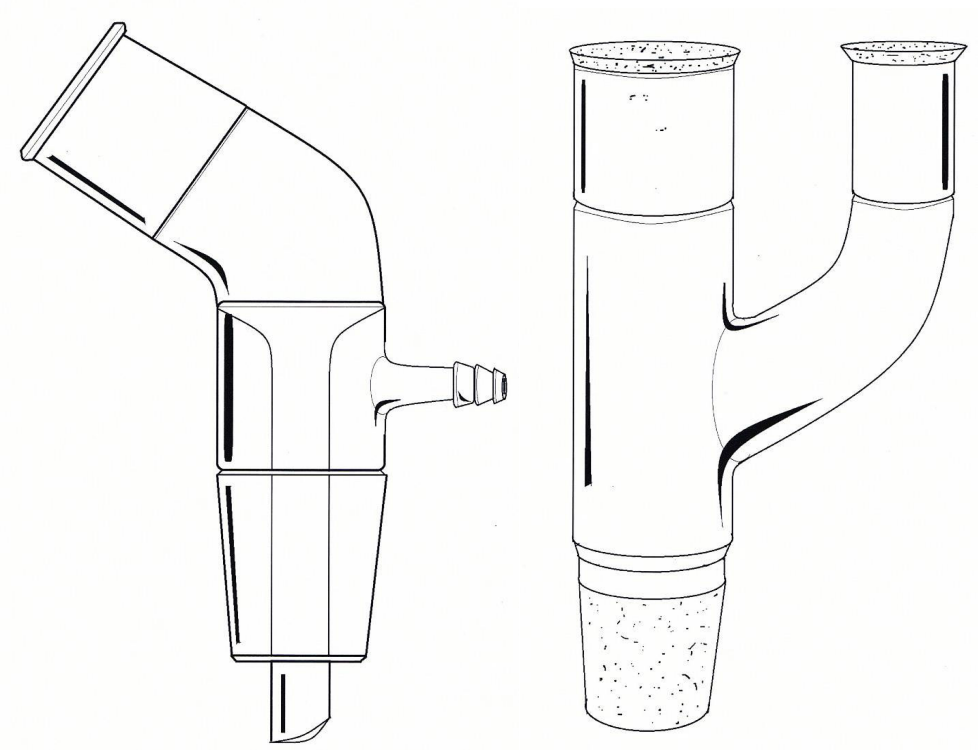
SEPARATORY FUNNEL





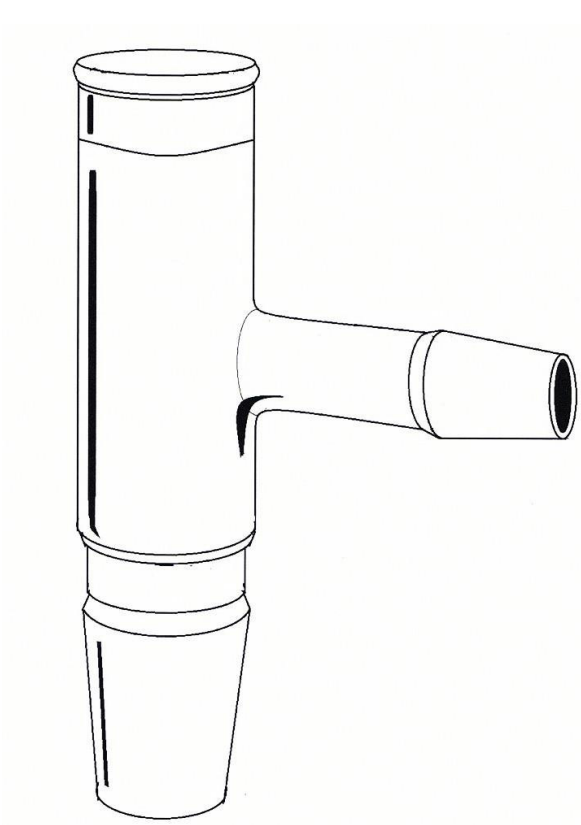
DISTILLING COLUMN


THERMOMETER
CONDENSER
BEADS
WATER OUT
WATER IN
COLLECTION FLASK
BOILING FLASK WITH STIR-BAR

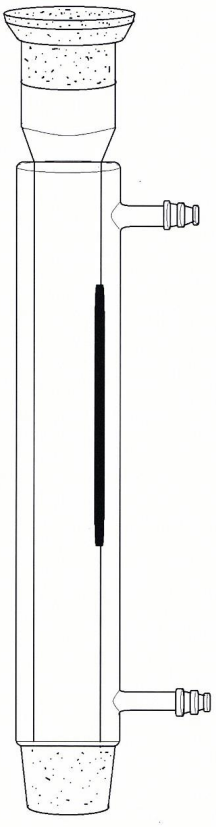


VACUUM ADAPTER

CLAISEN ADAPTER



DISTILLATION ADAPTER



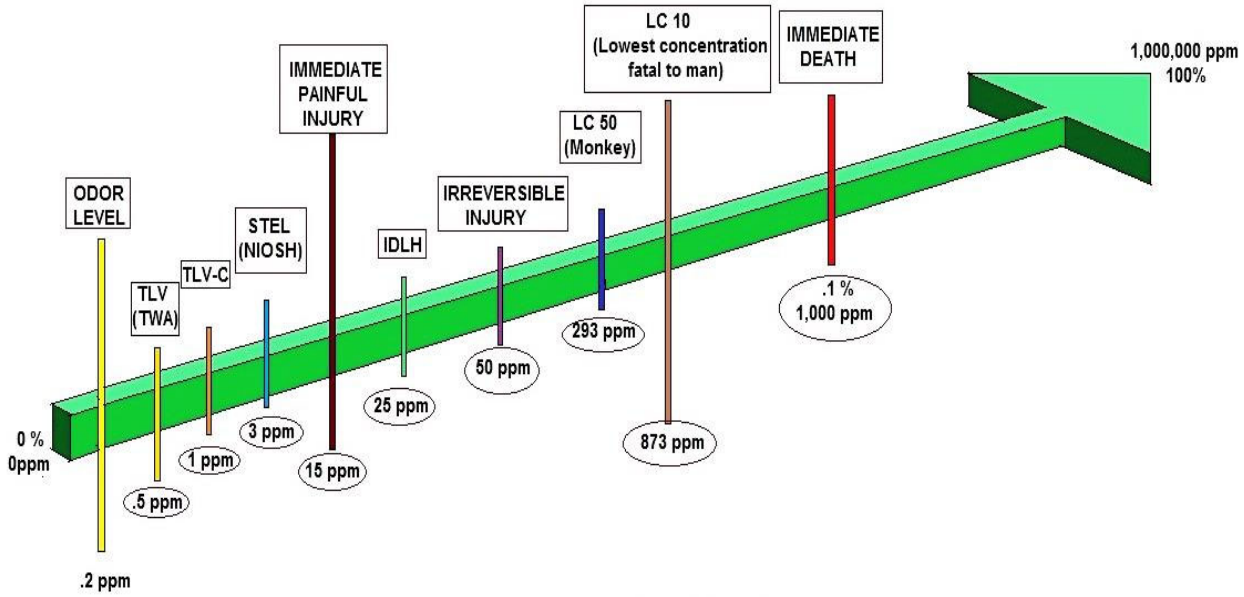
WEST CONDENSER

CARL WILHELM SCHEELE (1742-1786)

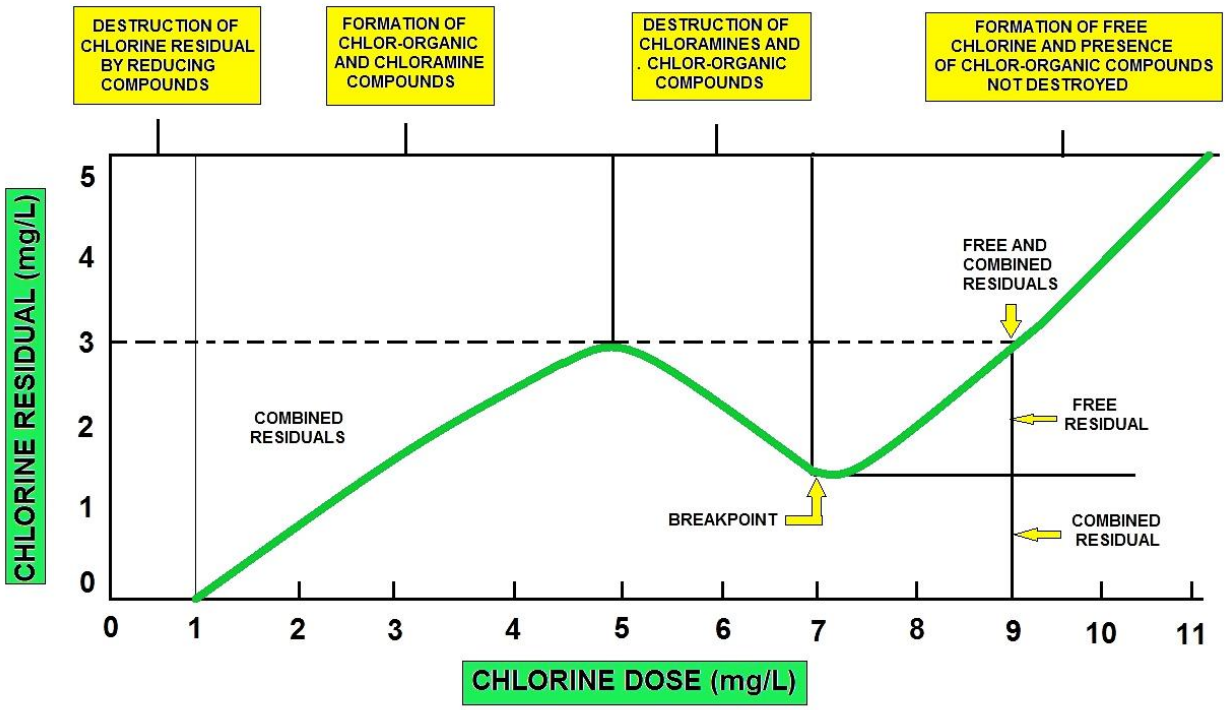
Carl Wilhelm Scheele

By the time he was a teenager, Scheele had learned the dominant theory of gases in the 1770s, the phlogiston theory. Phlogiston, classified as "matter of fire", was supposed to be released from any burning material, and when it was exhausted, combustion would stop. When Scheele discovered oxygen he called it "fire air" because it supported combustion, but he explained oxygen using phlogistical terms because he did not believe that his discovery disproved the phlogiston theory. Before Scheele made his discovery of oxygen, he studied air. Air was thought to be an element that made up the environment in which chemical reactions took place but did not interfere with the reactions. Scheele's investigation of air enabled him to conclude that air was a mixture of "fire air" and "foul air;" in other words, a mixture of two gases. He performed numerous experiments in which he burned substances such as saltpeter (potassium nitrate), manganese dioxide, heavy metal nitrates, silver carbonate and mercuric oxide. In all of these experiments, he isolated gas with the same properties: his "fire air," which he believed combined with phlogiston to be released during heat-releasing reactions. However, his first publication, *A Chemical Treatise on Air and Fire*, was not released until 1777, at which time both Joseph Priestley and Lavoisier had already published their experimental data and conclusions concerning oxygen and the phlogiston theory.

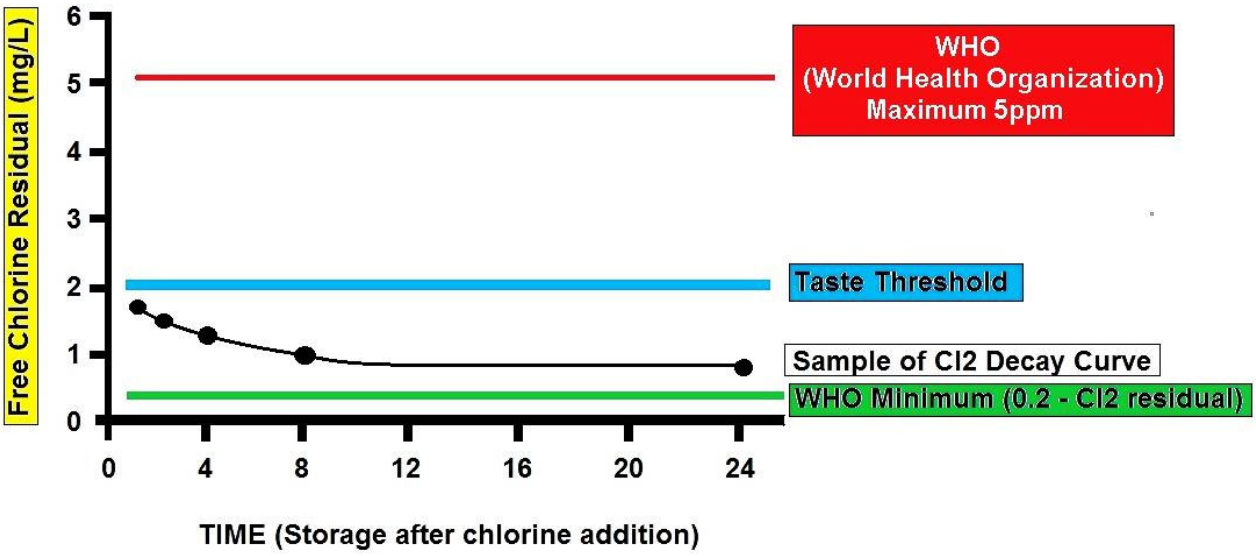
Chlorine Safety Charts



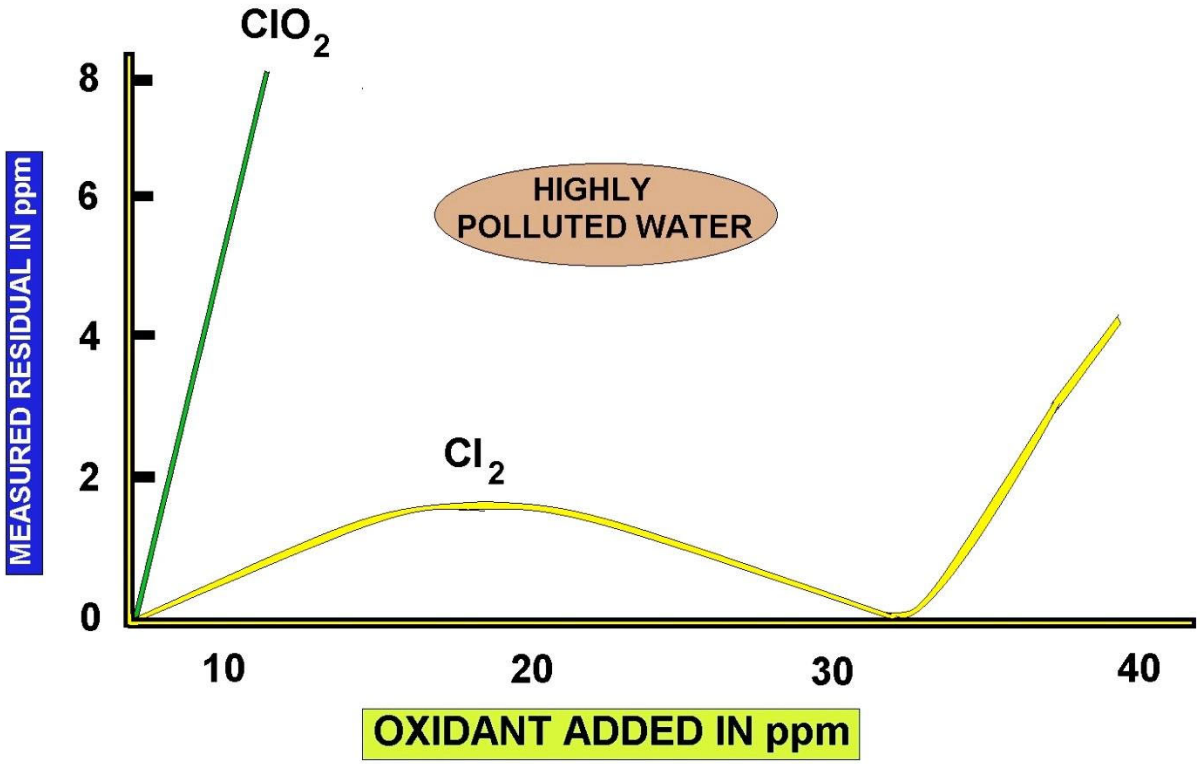
CHLORINE POISON LINES



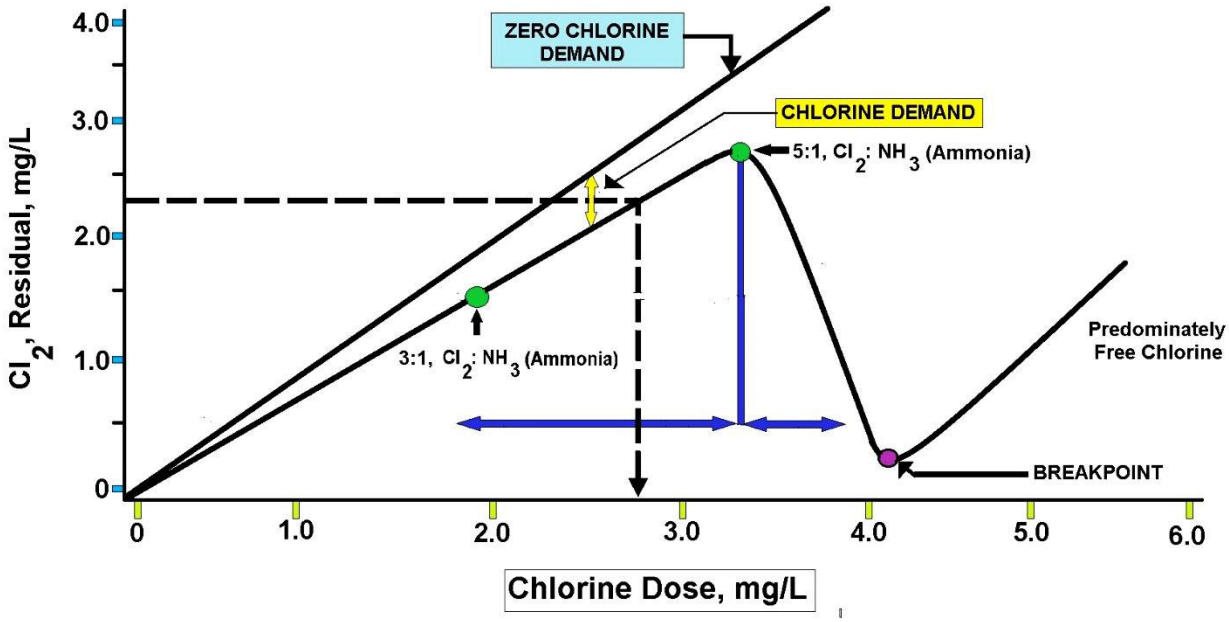
CHLORINE BREAKPOINT



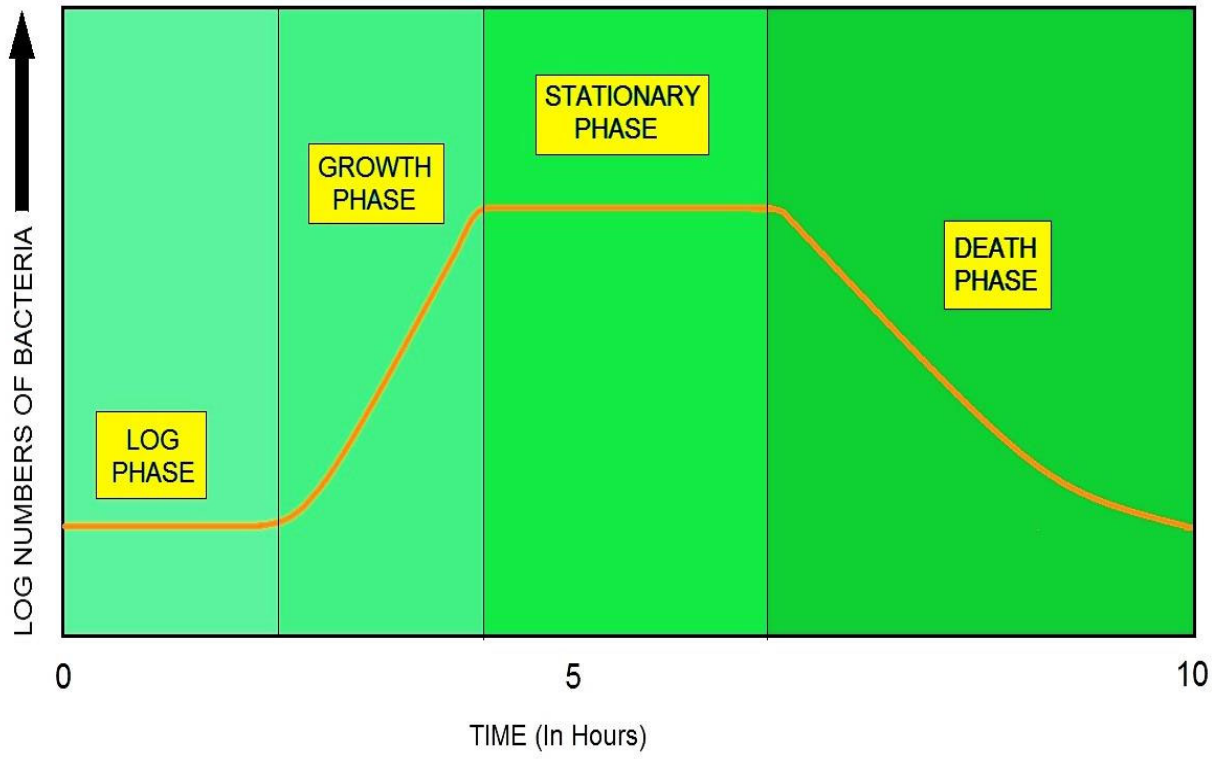
CHLORINE DECAY CURVE

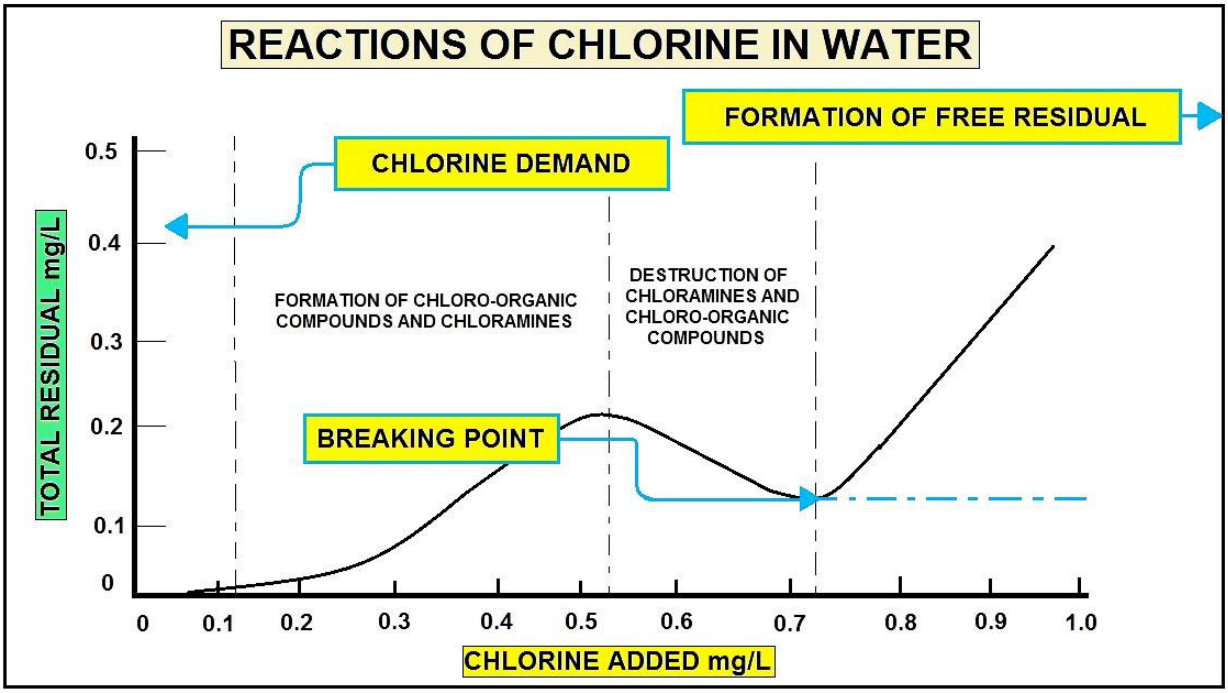


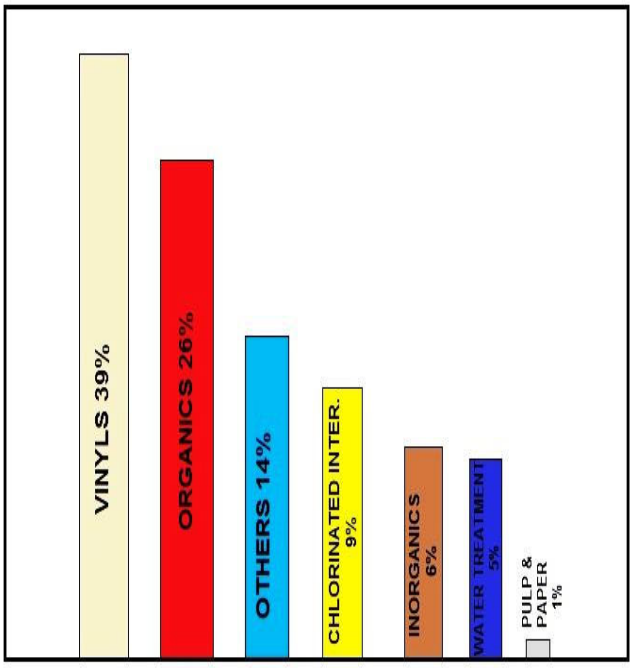
USING CHLORINE DIOXIDE vs CHLORINE

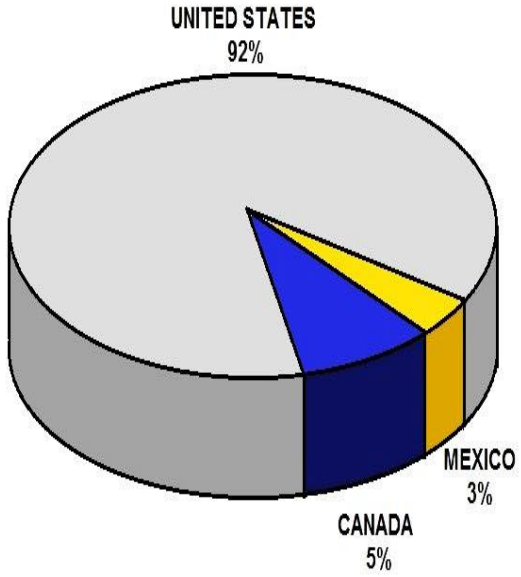


CHLORAMINATION

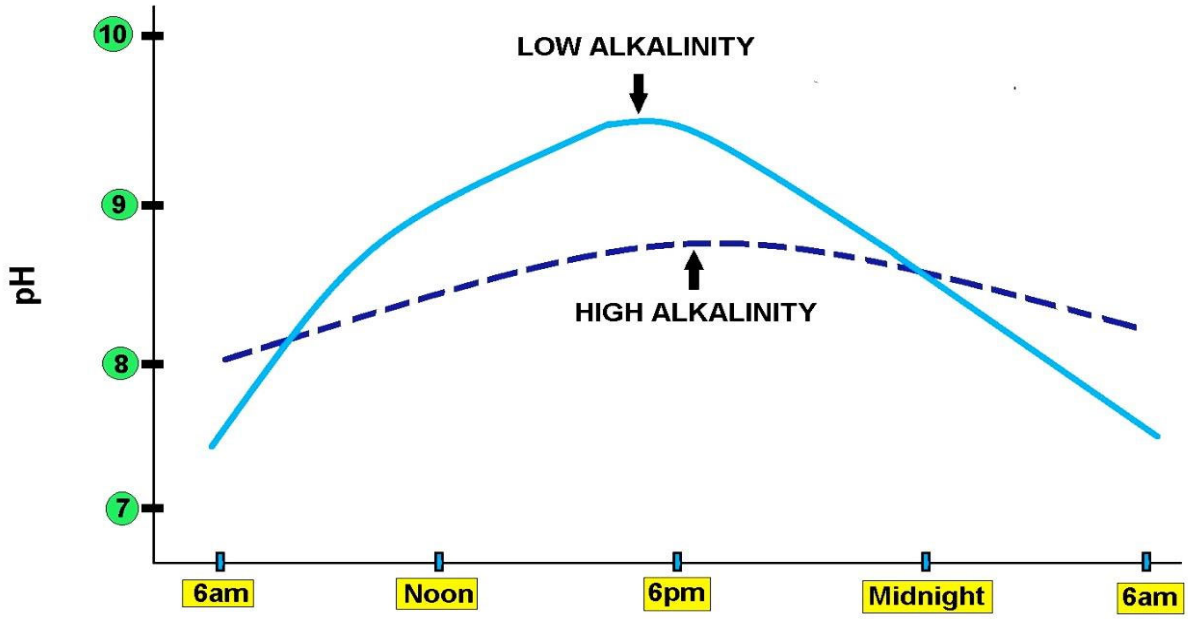


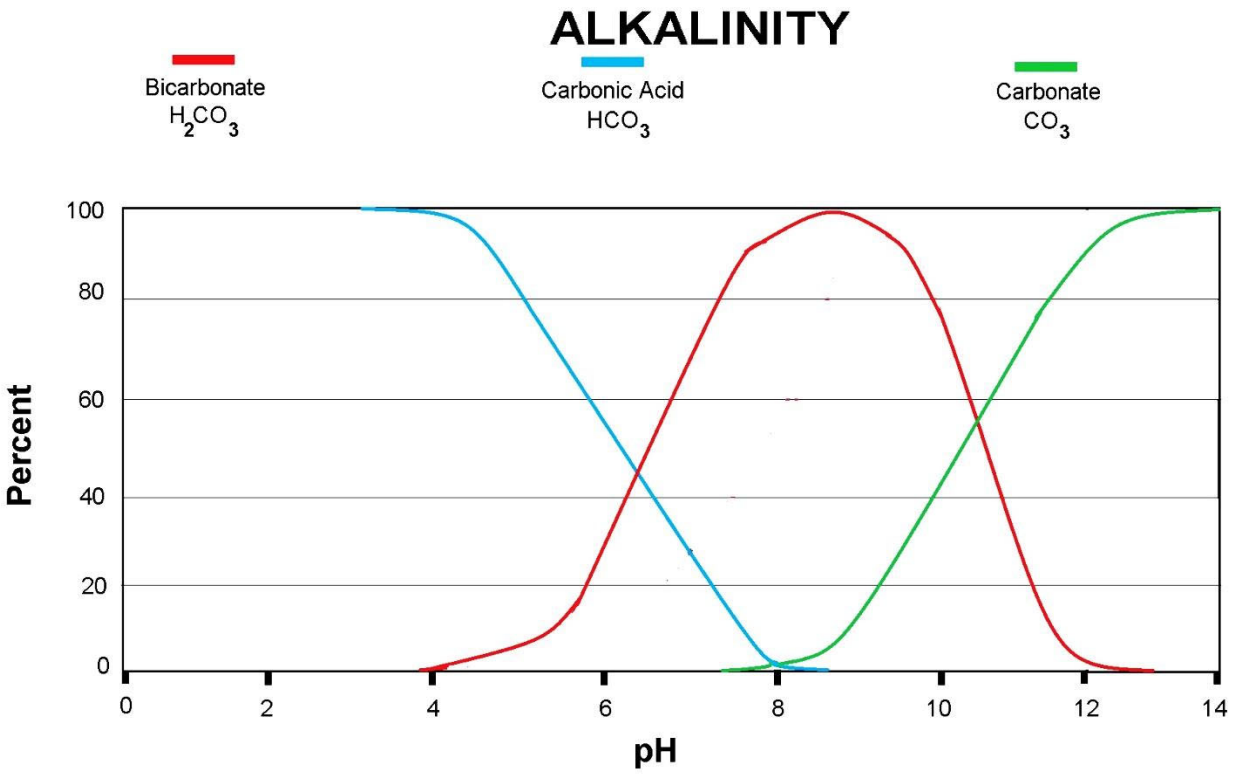






NORTH AMERICA CHLORINE DEMAND COMPARISON

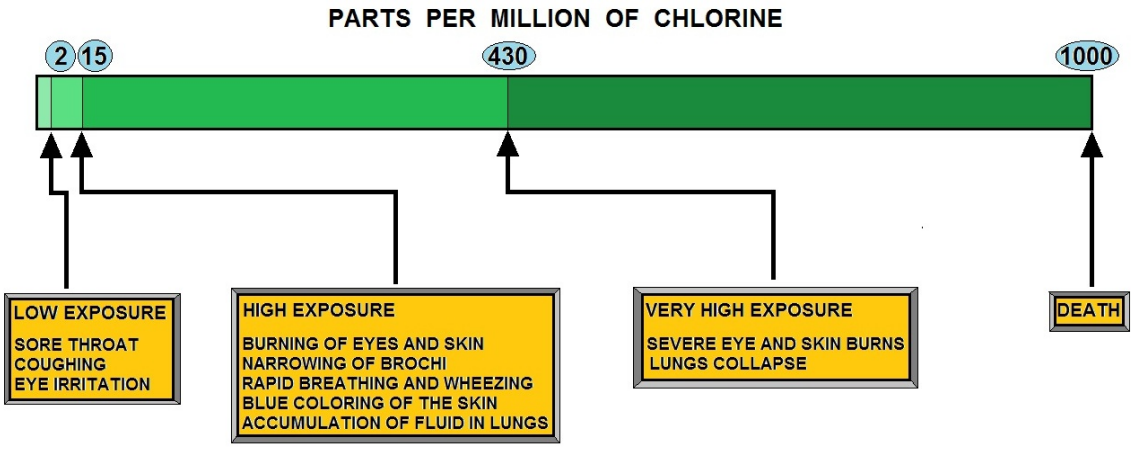




EFFECTS OF ALKALINITY FROM pH

EXPOSURE LEVELS (ppm)	EFFECTS OF CHLORINE ON HUMANS
0.2 - 0.4 ppm	ODOR THRESHOLD (VARIES BY INDIVIDUAL)
Less than 0.5 ppm	NO KNOWN ACUTE OR CHRONIC EFFECT
0.5 ppm	ACGIH 8-HOUR TIME WEIGHTED AVERAGE
1.0 ppm	OSHA CEILING LEVEL (PEL) TLV-STEL ERPG - 1
1.0 - 10 ppm	IRRITATION OF THE EYES AND MUCOUS MEMBRANES OF THE UPPER RESPIRATORY TRACT. SEVERITY OF SYMPTOMS DEPENDS ON THE CONCENTRATIONS AND LENGTHS OF EXPOSURE
3 ppm	ERPG-2 (EMERGENCY RESPONSE PLANNING GUIDELINES AS VALUES DEVELOPED BY AIHA) IS THE MAXIMUM AIRBORNE CONCENTRATION BELOW WHICH IT IS BELIEVED THAT NEARLY ALL INDIVIDUALS COULD BE EXPOSED FOR UP TO 1-HOUR WITHOUT EXPERIENCING OR DEVELOPING IRREVERSABLE OR OTHER SERIOUS HEALTH EFFECTS THAT COULD IMPAIR AN INDIVIDUAL'S ABILITY TO TAKE PROTECTIVE ACTION.
10 ppm	NIOSH IDLH (IMMEDIATELY DANGEROUS TO LIFE AND HEALTH)
20 ppm	ERPG-3 IS THE MAXIMUM AIRBORNE CONCENTRATION BELOW WHICH IT IS BELIEVED THAT NEARLY ALL INDIVIDUALS COULD BE EXPOSED FOR UP TO 1-HOUR WITHOUT EXPERIENCING OR DEVELOPING LIFE-THREATENING HEALTH EFFECTS.

EFFECTS OF CHLORINE EXPOSURE IN PARTS PER MILLION

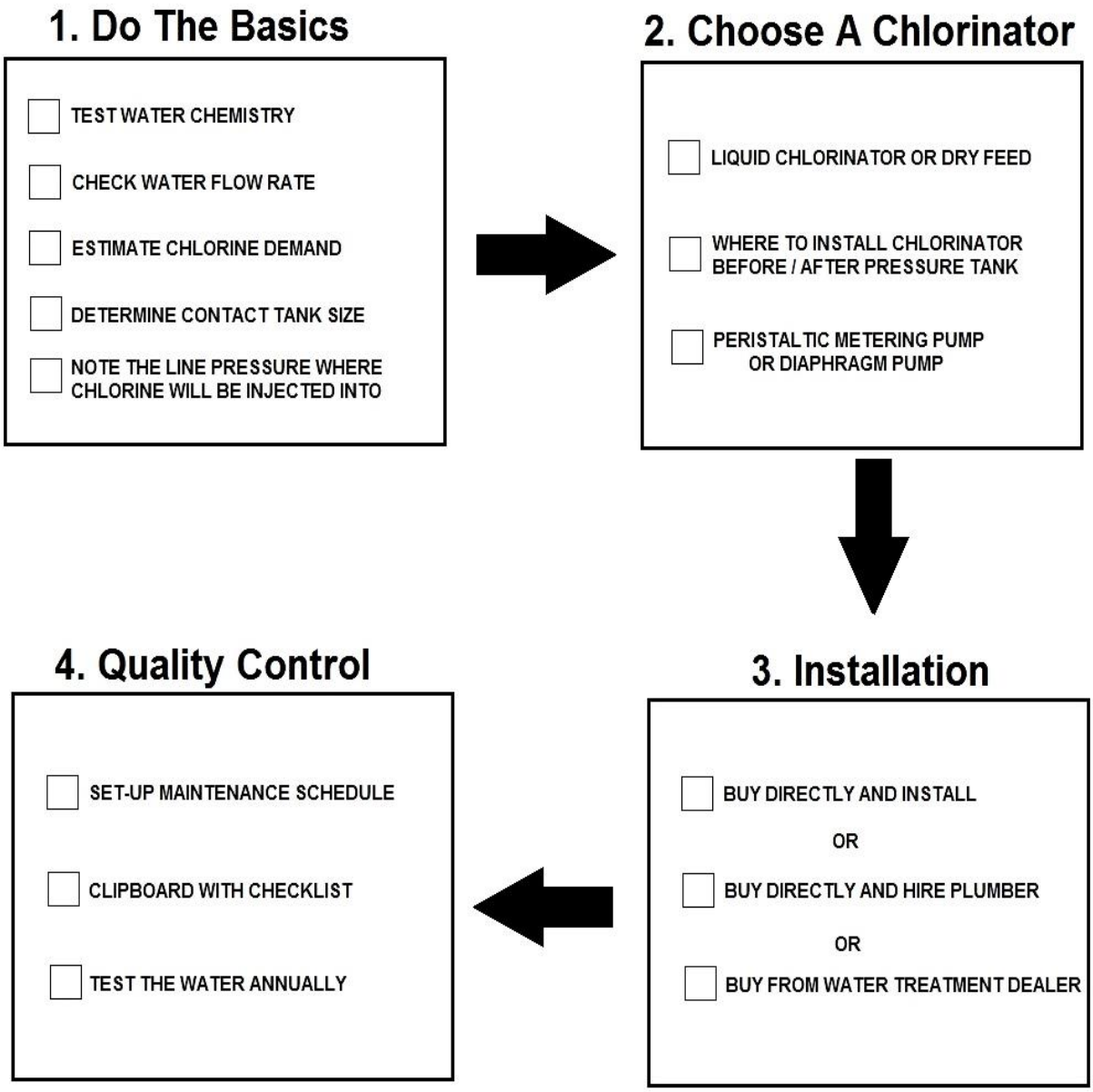


EFFECTS OF CHLORINE GAS ON HEALTH

WATER	BLEACHING POWDER (25 - 35 %) (g)	HIGH STRENGTH CALCIUM HYPOCHLORITE (70 %) (g)	LIQUID BLEACH (5 % SODIUM HYPOCHLORITE) (ml)
1	2.3	1.0	14
1.2	3.0	1.2	17
1.5	3.5	1.5	21
2	5.0	2.0	28
2.5	6.0	2.5	35
3	7.0	3.0	42
4	9.0	4.0	56
5	12	5.0	70
6	14	6.0	84
7	16	7.0	98
8	19	8.0	110
10	23	10	140
12	28	12	170
15	35	15	210
20	50	20	280
30	70	30	420
40	90	40	560
50	120	50	700
60	140	60	840
70	160	70	980
80	190	80	1 100
100	230	100	1 400
120	280	120	1 700
150	350	150	2 100
200	470	200	2 800
250	580	250	3 500
300	700	300	4 200
400	940	400	5 600
500	1 170	500	7 000

(* Approximate dose = 0.7 mg of applied Chlorine per litre of water)

CHLORINE DOSES WITH DIFFERENT TYPES OF CHLORINE



HOW TO DETERMINE A CHLORINATION SYSTEM

HOW TO CALCULATE CHLORINE DOSAGE TO DISINFECT A WELL USING CALCIUM HYPOCHLORITE

EQUIPMENT

- 20 litre bucket
- HSCH Chlorine granules or powder

METHOD

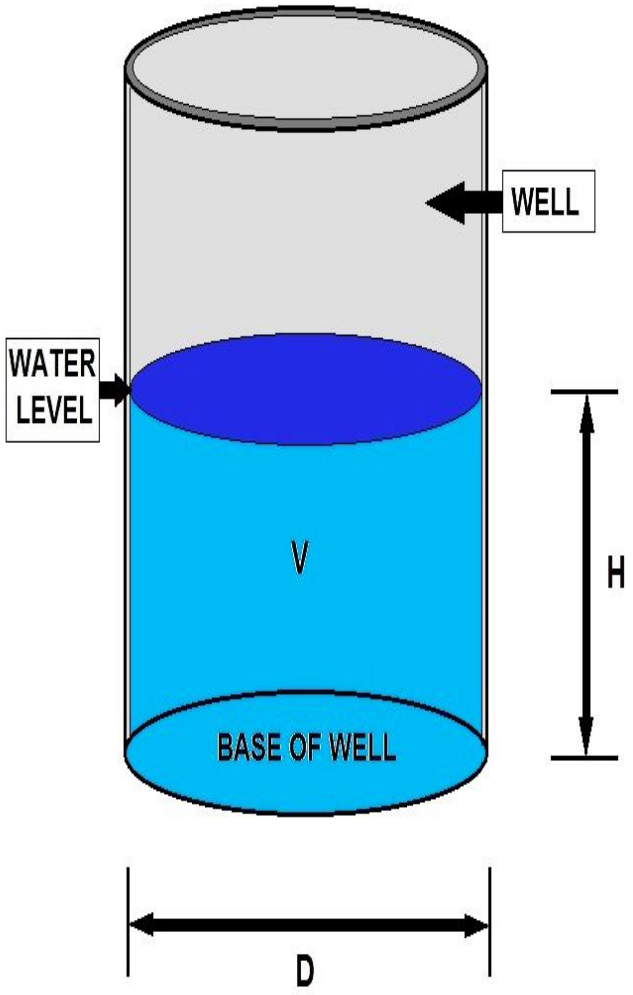
- Calculate the volume of water in the well using formula:

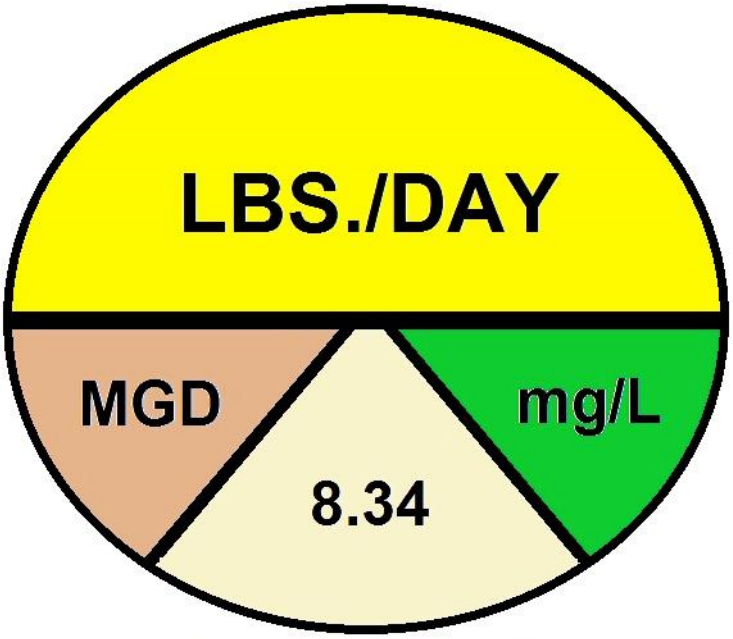
$$V = \frac{\pi D^2 h}{4}$$

WHERE

V = Volume of water
D = Diameter
h = Depth of water
π = 3.142

- Fill bucket with clear water from source
- Add about 300g of HSCH and stir (dissolve)
- For every cubic meter of water, add 10 litres (half bucket) of chlorine solution.
- Double the quantity of HSCH added if the solution is to be used for cleaning well lining or aprons





POUNDS FORMULA WHEEL

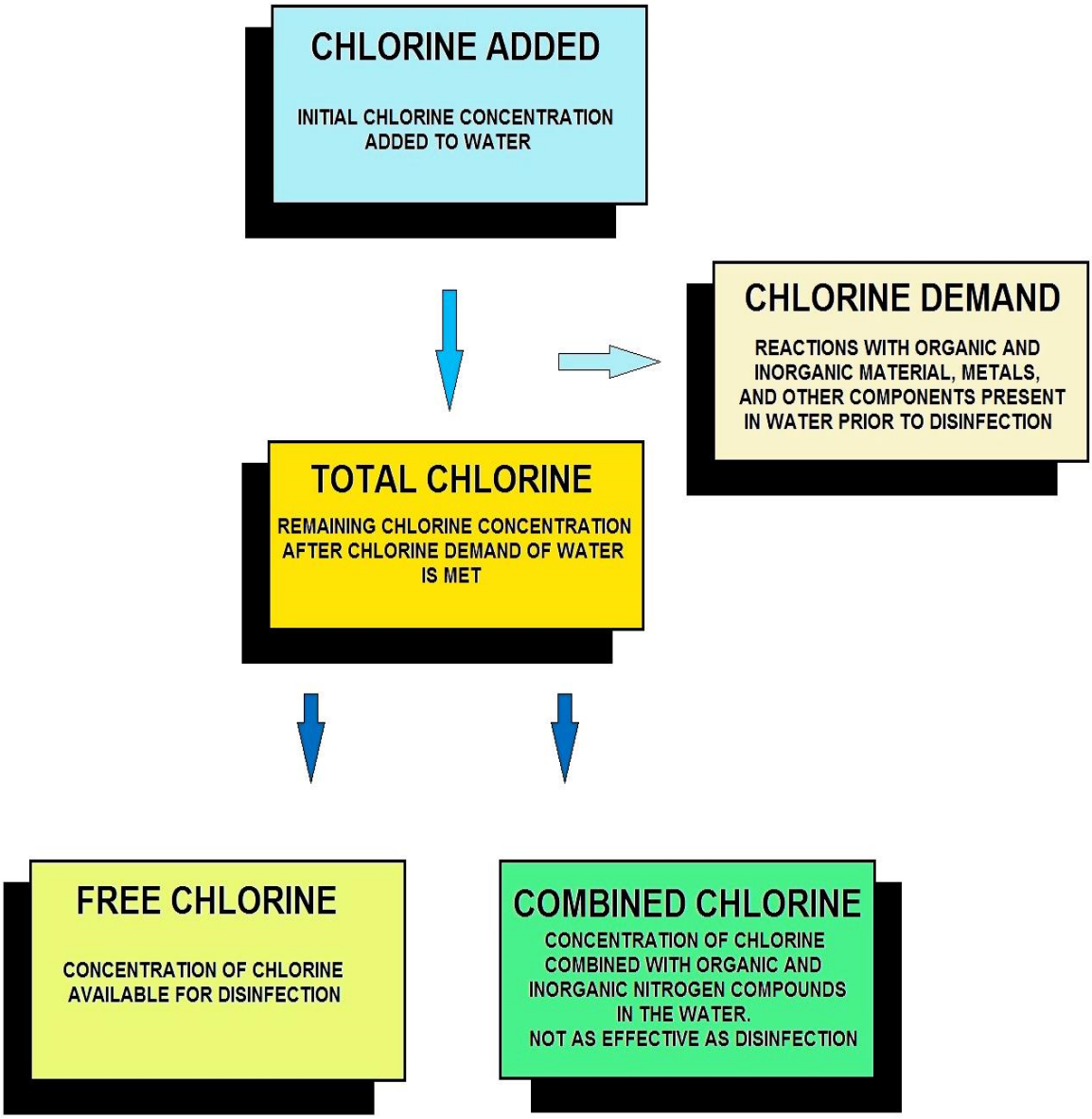
$$\text{DOSE , mg/L} = \frac{(332)\ \text{lbs. / day}}{(5.27)\ \text{MGD x 8.34 lbs./mg/L/MG}}$$

$$\text{DOSE , mg/L} = (7.6)\ \text{mg/L}$$

DOSE CALCULATION EXAMPLE

DENSITY (at 32°F & 1 atm)	0.2006 lbs. / cu.ft.
SPECIFIC GRAVITY (at 32°F & 1 atm)	2.482 (air = 1)
LIQUEFYING POINT (at 1 atm)	−30.1°F
VISCOSITY (at 68°F)	0.01325 centipose
SOLUBILITY IN WATER	60.84 lbs. / 1000 gal.

PROPERTIES OF GASEOUS CHLORINE



CHLORINE DISINFECTION

We welcome you to complete the assignment in Microsoft Word. You can easily find the assignment at www.abctlc.com.

Once complete, just simply fax or e-mail the answer key along with the registration page to us and allow two weeks for grading.

Once we grade it, we will e-mail a certificate of completion to you. Call us if you need any help.

If you need your certificate back within 48 hours, you may be asked to pay a rush service fee of $50.00.

You can download the assignment in Microsoft Word from TLC's website under the Assignment Page. www.abctlc.com

You will have 90 days in order to successfully complete this assignment with a score of 70% or better.

If you need any assistance, please contact TLC's Student Services. Once you are finished, please mail, e-mail or fax your answer sheet along with your registration form.