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Resources Available from the Division of Safety & Hygiene (DSH) Libraries

(800) 644-6292 (614) 466-7388
library@bwc.state.oh.us
www.ohiobwc.com

Safety training:

- Safety talks, outlines and scripts - DSH Safety leader's discussion guide, Training Center's One-hour safety presentations, reference books, web resources
- Videos – hundreds of safety and health topics
- Books and articles on training techniques

Machine and equipment safety:

- Safety standards (ANSI, NFPA, CGA)
- Books and articles on power presses, material handling equipment, lockout/tagout, etc.

Sample written programs:

- DSH program profiles and sample written programs
- Reference books
- Internet resources

Illness and injury statistics:

- Statistics from the U.S. Bureau of Labor Statistics
- National Safety Council's *Injury Facts*
- National Institute of Occupational Safety & Health (NIOSH) studies

Hazard communication and chemical safety:

- Chemical safety information
- Material safety data sheets (MSDSs)
- Sample written programs
- Videos
- Internet resources

Safety standards

- American National Standards Institute (ANSI) standards (including standards for construction, machinery and equipment, personal protective equipment)
- National Fire Protection Association (NFPA) fire codes (including the Life Safety Code and the National Electrical Code)
- Compressed Gas Association (CGA) standards

Other topics of interest (books, articles, magazines, videos and standards):

- Confined spaces
- Electrical safety
- Job safety analysis
- New employee orientation
- Powered industrial trucks
- Respiratory protection
- Scaffolds
- Spill response

Directories and lists of vendors of safety equipment

Occupational Safety & Health Administration (OSHA) regulations

Manual of Uniform Traffic Control Devices (MUTCD)

Recommendations of useful Internet sites

BWC publications

Saving You Time and Research

Requests for copies of OSHA standards, information on starting a safety committee, a video on accident investigation techniques -- these are some of the thousands of inquiries BWC's Division of Safety & Hygiene (DSH) libraries receive each year.

DSH has two libraries to serve you:

- The central library in the William Green Building in downtown Columbus;
- The resource center and video library located at the Ohio Center for Occupational Safety and Health (OCOSH) in Pickerington.

Both libraries are open 8 a.m. to 4:45 p.m., Monday through Friday. Your need for information does not require a visit to the library. You can phone, fax, or e-mail your requests and receive a quick response.

The central library provides free information services on the topics of occupational safety and health, workers' compensation and rehabilitation.

The OCOSH resource center provides similar services for those who visit OCOSH for meetings and training center classes.

The video library offers an extensive collection of videotapes to supplement your organization's safety and health training program. It is a convenient and popular source for Ohio employers to borrow quality occupational safety- and health-related training aids.

Visit our Web site at **www.ohiobwc.com.**

Central library
30 W. Spring St., Third Floor
Columbus OH 43215-2256
1-800-OHIOBWC
(614) 466-7388
(614) 644-9634 (fax)
library@bwc.state.oh.us

OCOSH resource center
13430 Yarmouth Drive
Pickerington OH 43147
1-800-OHIOBWC
Resource center (614) 728-6464
Video library (614) 644-0018

INTERNET WEB SITES
FOR
OCCUPATIONAL SAFETY & HEALTH INFORMATION
April 2005

GENERAL

NATIONAL SAFETY COUNCIL (NSC)
http://www.nsc.org/

The NSC has a user friendly web site for innovative and current information on home, farm and community, on the road and workplace safety and as well statistical data and charts.

NORTH DAKOTA WORKFORCE SAFETY & INSURANCE
http://www.workforcesafety.com/

For workplace safety, North Dakota's WSI site puts forth their "safe operating procedures" page where they give information on accident and near miss reports, substance abuse, material handling and storage, walking and working surfaces, and safety program development and orientation.

OCCUPATIONAL & INDUSTRIAL SAFETY RESOURCES
http://www.khake.com/page59.html

Maintained by a Vocational Information Center, this web site provides links to occupational and industrial safety with lists of directories, national centers, hotlines and help lines as well as specific area coverage such as emergency, disaster and natural hazards, and tool, machine and equipment safety options.

OKLAHOMA STATE UNIVERSITY
http://www.pp.okstate.edu/ehs/

The Department of Environmental Health & Safety at OSU offers an online safety resource library that is constantly being updated with topics from A-Z including specific areas of safety such as fire, construction, HAZCOM and training. Go to the "Links Library" option.

SAFETY DIRECTORY
http://www.safetydirectory.com/

Safety Directory.com is an Internet gateway to occupational health & safety sites. This web site is indexed with information on industry specific topics, training, illness and injury, as well as safety publications and resources.

FEDERAL GOVERNMENT

CENTERS FOR DISEASE CONTROL & PREVENTION (CDC)
http://www.cdc.gov/

The CDC is always a good resource for current medical issues throughout the United States. Health topics from A-Z give an in-depth look at most communicable diseases as well as topics such as safe driving, violence, and air pollution, and workplace safety and health topics.

FEDERAL EMERGENCY MANAGEMENT ASSOCIATION (FEMA)
http://www.fema.gov/

For up-to-date information on active disasters and emergencies nationwide access this web site first. Publications include options for emergency preparedness and prevention, response and recovery, disaster fact sheets, and public awareness information.

NATIONAL INSTITUTE FOR OCCUPATIONAL SAFETY & HEALTH (NIOSH)
http://www.cdc.gov/niosh/homepage.html

NIOSH's web site provides current information on many services as well as safety research, including ergonomics programs, respirators, and mining safety. At the chemical page you will find databases and other helpful resources, information on personal protective equipment, as well as government agency web sites of interest.

OCCUPATIONAL SAFETY & HEALTH ADMINISTRATION (OSHA)
http://www.osha.gov

OSHA'S official web site includes media releases, online publications, statistics, standards & directives, "Technical Links," training center courses, "hot topics," and "what's new" as well a very useful A-Z index page.

INTERNATIONAL RESOURCES

HEALTH & SAFETY EXECUTIVE (HSE)
http://www.hse.gov.uk/

The United Kingdom has an international safety web site with a good deal to offer on occupational safety & health. Drop down boxes offer A-Z industry information, health and safety topics, tools, research, as well as publications and statistics.

ERGNET
http://www.sunderland.ac.uk/~ts0gli/ergnet.htm

The University of Sunderland in the UK is an international web site directory of "places for ergonomics and human factors". Featuring lists of sources such as societies, organizations, government bodies, institutes, centers and laboratories, this site also gives links to journals, a research database and other general ergonomic sites.

OHIO

OHIO EPA (OEPA)

http://www.epa.state.oh.us

At the official web site for Ohio's Environmental Protection Agency; use the "Topic Index" to find regulations and information on permits, hazardous waste, pollution prevention, wastewater, wetlands, and much more.

OHIO STATE LIBRARY/OHIOLINK
http://winslo.state.oh.us

At **OhioLink**, a statewide library and information network, you can search the State Library of Ohio's collection for the BWC's Division of Safety & Hygiene library books as well as other Ohio College and university library collections. Also available at this web site are searchable versions of Ohio Administrative laws and rules, electronic databases, and other Ohio library directories.

SPECIFIC (BY SUBJECT)

CONSTRUCTION
http://www.cdc.gov/elcosh/index.html

CDC's **eLCOSH** is a comprehensive library of construction-related safety information presented in both English and Spanish with items listed under trade, hazard, job site, and others. Also see: The Construction Industry Safety Council, a Center to Protect Workers' Rights resource center at ***http://www.buildsafe.org/RSC.htm*** for OSHA publications in PDF and hazard alerts.

ERGONOMICS
http://www.ergoweb.com

ERGOWEB provides current information on ergonomics and human factor science. Offered are: research, case studies, reference material and a forum for questions, answers and discussion.

LABORATORY SAFETY
http://safety.science.tamu.edu/

Texas A&M University College of Science is an optional choice for safety in the laboratory information. From hazard identification to waste disposal this web site offers thorough coverage of laboratory safe practices.

MATERIAL SAFETY SHEETS
http://www.ilpi.com/msds/index.html

This web site offers many solutions for finding MSDS (100 free sites) as well as chemical manufacturers and suppliers, pesticides including fertilizers, government sites, and other miscellaneous locations for chemical data. Also check any toxicological effects at *http://www.atsdr.cdc.gov/toxprofiles/* and health and safety information on household chemical ingredients at *http://householdproducts.nlm.nih.gov/*.

MOTOR CARRIER SAFETY PROGRAMS

http://www.fmcsa.dot.gov/safetyprogs/saftprogs.htm

The Federal Motor Carrier Safety Administration (FMCSA), an administration within the U.S. Department of Transportation, regulates and supports the Nation's interstate commercial carrier industry. The FMCSA web page offers several safety programs in PDF format such as brake safety, fatigue, HAZMAT safety, speed management, sharing the road safely, and other insurance and licensing information.

RADIATION
http://www.physics.isu.edu/radinf/

The Radiation Information Network offers a web site that is in-depth with information on radiation topics and issues. In addition to what's new in the field and general information there are regulatory, organizational and society links as well as research and educational resources available to access.

SAFETY STATISTICS
http://stats.bls.gov/

Occupational health and safety statistics by industry and occupation can be researched for injuries, illnesses, and fatality data at this web site starting with the "Overview of BLS Statistics on Worker Safety and Health" page.

SAFETY BRIEFINGS, MANUALS, PRODUCTS & PROGRAMS

OSHA POWERPOINT SAFETY PRESENTATIONS
http://esf.uvm.edu/sirippt/powerpt.html

An extensive safety PowerPoint presentation library is available at this web site featuring A-Z topics such as accident investigations, bomb threats, chemical spills, construction, electrical, hand tools, emergency response, fire safety, forklifts, JSA, laser, OSHA compliance, PPE, razor knife safety, safe lifting, and many more.

SAFETY PUBLICATIONS & VIDEO RESOURCES
http://www.cbs.state.or.us/external/osha/standards/pub.htm

A valuable resource for safety resources, the Oregon State's Department of Consumer and Business Publications web site is packed with downloadable information. Areas covered are agriculture, asbestos abatement, occupational exposures, HAZCOM, HAZMAT, HAZWOPER, safety practices, writing manuals and programs, tools of the trade, workers' compensation and ergonomics.

Laboratory Safety
Introduction to Laboratory Safety, Emergency Response, and Accident Reporting

1. Powerpoint Presentation
    a. Introduction, Class Format
    b. Objectives
    c. Questions to ponder
    d. Emergency Response
        i. Medical
            1. Accident Reporting
        ii. Fire
        iii. Chemical
        iv. Building Evacuations
    e. Why Should I Be Concerned About Safety?
    f. How Do I Reduce or Minimize My Exposure?
    g. Case Study
    h. Answers to Questions in "c."
2. Video on Spill Control

Web Information

OSU Environmental Health and Safety: http://www.ehs.ohio-state.edu/
OSU Dept. of Chemistry Safety Page: http://www.chemistry.ohio-state.edu/ehs/
OSHA Recordkeeping Page: http://www.osha.gov/recordkeeping/index.html
BWC Division of Safety & Hygiene Training Center:
http://www.bwc.state.oh.us/employer/programs/safety/SandHEducation.asp
American Red Cross: http://www.redcross.org/
American National Standards Institute: http://www.ansi.org/

Recommended Reading

Prudent Practices in the Laboratory: Handling and Disposal of Chemicals, NAS, 1995
Safety in Academic Chemistry Laboratories, ACS, 2003
Accident Prevention Manual, National Safety Council

Laboratory Safety

Introduction to Laboratory Safety, Emergency Response, and Accident Reporting

Laboratory Safety

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http://www.chemistry.ohio-state.edu/ehs

Laboratory Safety

Class Format

- Lecture
- Video/Demonstration
- Questions
- Frequent Breaks

Laboratory Safety

Objectives:

- **Raise your Awareness of Safety**
- **Present the "Fundamentals" of Laboratory Safety**
- **Complete "Awareness-Level" Training in the Hazard Communication and the Laboratory Standards**

Laboratory Safety

Objectives

What We CANNOT Provide:

- **In-Depth or Detailed Information**
- **SOP's for Specific Processes or Equipment**
- **"Certification"**

Laboratory Safety

Questions:

1. What are the top three leading causes of death for U.S. workers (while on the job)?
2. How many worker deaths were there in 2000?
3. How many occupational injuries and illnesses were there in 1999?
4. How many unintentional deaths took place in the home?
5. Which industry is the most dangerous?
6. How much did worker injuries cost Americans in 2001?

Laboratory Safety

Emergency Response:

- Medical
- Fire
- Chemical
- Building Evacuations

Laboratory Safety

Emergency Response-Medical

Common Laboratory Accidents:

- Burns (Chemical and Thermal)
- Cuts and Punctures
- Inhalation of Hazardous Materials
- Contamination of Skin and Clothing
- Ingestion of Hazardous Materials
- Electrical Shock

Laboratory Safety

Emergency Response-Medical

- **Call 911 to Report the Emergency**
- **Provide the Minimum First-Aid Necessary**
- **Follow Other Departmental Procedures**
- **Complete Recordkeeping Requirements**

Laboratory Safety

Emergency Response-Medical

- **Sign Up for CPR Training**
- **First Aid in the Workplace Through BWC**

Laboratory Safety

Emergency Response-Medical-Calling 911

- **Report the Location**
- **Nature of the Emergency**
- **The Dispatcher May Ask Questions**
- **Hang Up After the Dispatcher Has**

Laboratory Safety

Emergency Response-Medical-Chemical Splashes

- **Get Victim to Safety Shower or Eye Wash Unit**
- **Flush for 15 Minutes or Until Help Arrives**
- **Have MSDS Handy**
- **Remove Contaminated Clothing**
- **DO NOT Perform Chemistry on a Splash Victim!!!**

Laboratory Safety

Emergency Response-Medical-Chemical Splashes

Laboratory Safety

Emergency Response-Chemical Splashes-EYES

- **Quick Response Is Important**
- **Flush for 15 Minutes**
- **You May Have to Force the Eyelids Open**
- **Have the Victim Roll Their Eyes Around In the Stream**

Laboratory Safety

Emergency Response-Medical-Chemical Splashes

Laboratory Safety

Emergency Response-Medical-Chemical Splashes

Laboratory Safety

Emergency Response-Medical Emergencies

- **Become Aware of Emergency Equipment Locations (Eye Wash Units, Safety Showers, etc…)**
- **Inspect Equipment Regularly**
- **Test Equipment per ANSI Z358.1**

Laboratory Safety

Emergency Response

Laboratory Safety

Accident Reporting

- **Required By OSHA (unless exempt)**
- **OSHA 300 Log and Form 301 (or equivalent)**
- **Sign Up for:**
  1. **Accident Analysis**
  2. **OSHA Recordkeeping**

Laboratory Safety

Accident Reporting

- **Useful for Workers' Comp**
- **Sign Up for:**
  1. **Controlling Costs Through Claims Management**
  2. **Controlling Workers' Compensation Costs**

Laboratory Safety

Fire Emergencies

- **Pull the Fire Alarm to Evacuate the Building**
- **Call 911 to Report the Emergency**

Laboratory Safety

Fire Emergencies

- **Follow Departmental Procedures**
- **The Fire Alarm May Only Notify Building Occupants: Call 911**

Laboratory Safety

Fire Emergencies-
If You Can Do So Without Endangering Yourself:

- **Isolate Fire (close lab door or sash)**
- **Isolate or Eliminate Ignition or Fuel Sources**
- **Use an APPROPRIATE Fire Extinguisher**

Laboratory Safety

Chemical Emergencies

- **Pull the Fire Alarm to Evacuate the Building**
- **Call 911 to Report the Emergency**

Laboratory Safety

Chemical Emergencies

- **The Release of a Large Quantity of Hazardous Material**
- **Small Quantity of an Acutely Dangerous Material**
- **Chemical "Unknown"**

Laboratory Safety

Chemical Emergencies-
If You Can Do So Without Endangering Yourself:

- **Isolate the Area**
- **Warn Others About the Danger**
- **Follow Departmental Procedures**

Laboratory Safety

Building Evacuations

- Unless specifically requested and considered advisable by those providing the assistance, moving persons in wheelchairs down a stairway is not recommended. One individual should remain with the disabled person, if this can be done without unreasonable personal risk. Others should evacuate the building and advise of the location of the persons remaining in the building so that the evacuation may be completed by the emergency personnel. Elevators should not be used to move persons with disabilities for the reasons outlined above.

Laboratory Safety

Building Evacuations

- The building should not be re-entered unless indicated safe by fire officials or Safety Personnel at the scene.

Laboratory Safety

Why Should I Be Concerned About Safety?

- To Protect the Health and Safety of Yourself and Your Colleagues
- To Comply With the Law(s)
- To Avoid Lawsuits

Laboratory Safety

How Do I Reduce or Minimize My Exposure?

- Planning, Planning, Planning
- Engineering Controls (Fume Hoods)
- Administrative Controls (Plans, Policies, SOP's, etc.)
- Personal Protective Equipment (Gloves, Goggles, etc.)

Laboratory Safety

Case Study

A Graduate Student was distilling a mixture of dichloromethane and crude material from an ozonolysis of Allyl Bromide, which he mistakenly thought was Bromoacetaldehyde. Unknown to the student, he was trying to distill a mixture of peroxides (that resulted from the ozonolysis). An explosion occurred when the temperature reached 50 degrees Centigrade.

Laboratory Safety

Case Study

The explosion destroyed the heating mantle and the ceramic top of the stirrer/hot-plate. The ceramic top fragmented and sent chards into the face, chest, shoulders, and hands of the student. Fortunately, the student was wearing safety glasses: one chard hit the left lens with such force that it shattered (but remained within the frame). Without the safety glasses, the student would have lost an eye (or worse).

Laboratory Safety

Case Study

What could have been done to prevent the accident?

Laboratory Safety

1. The top three leading causes of death for U.S. workers (while on the job) are:

Highway incidents followed by falls and homicides

2. How many worker deaths in 2000?

5,915

Laboratory Safety

3. How Many Occupational Injuries and Illnesses in 1999?

5.7 Million

4. How Many Unintentional Deaths Took Place in the Home?

33,200

Laboratory Safety

5. Which Industry Is the Most Dangerous?

Agriculture

6. How Much Did Worker Injuries Cost Americans in 2001?

$137 Billion or $970 Per Worker

OSHA
Forms for Recording
Work-Related Injuries and Illnesses

U.S. Department of Labor
Occupational Safety and Health Administration

Dear Employer:

This booklet includes the forms needed for maintaining occupational injury and illness records for 2004. These new forms have changed in several important ways from the 2003 recordkeeping forms.

In the December 17, 2002 Federal Register (67 FR 77165-77170), OSHA announced its decision to add an occupational hearing loss column to OSHA's Form 300, Log of Work-Related Injuries and Illnesses. This forms package contains modified Forms 300 and 300A which incorporate the additional column M(5) Hearing Loss. Employers required to complete the injury and illness forms must begin to use these forms on January 1, 2004.

In response to public suggestions, OSHA also has made several changes to the forms package to make the recordkeeping materials clearer and easier to use:

- On Form 300, we've switched the positions of the day count columns. The days "away from work" column now comes before the days "on job transfer or restriction."
- We've clarified the formulas for calculating incidence rates.
- We've added new recording criteria for occupational hearing loss to the "Overview" section.
- On Form 300, we've made the column heading "Classify the Case" more prominent to make it clear that employers should mark only one selection among the four columns offered.

The Occupational Safety and Health Administration shares with you the goal of preventing injuries and illnesses in our nation's workplaces. Accurate injury and illness records will help us achieve that goal.

Occupational Safety and Health Administration
U.S. Department of Labor

What's Inside...

In this package, you'll find everything you need to complete OSHA's *Log* and the *Summary of Work-Related Injuries and Illnesses* for the next several years. On the following pages, you'll find:

- ***An Overview: Recording Work-Related Injuries and Illnesses —*** General instructions for filling out the forms in this package and definitions of terms you should use when you classify your cases as injuries or illnesses.
- ***How to Fill Out the Log —*** An example to guide you in filling out the *Log* properly.
- ***Log of Work-Related Injuries and Illnesses —*** Several pages of the *Log* (but you may make as many copies of the *Log* as you need.) Notice that the *Log* is separate from the *Summary*.

- ***Summary of Work-Related Injuries and Illnesses —*** Removable *Summary* pages for easy posting at the end of the year. Note that you post the *Summary* only, not the *Log*.

- ***Worksheet to Help You Fill Out the Summary —*** A worksheet for figuring the average number of employees who worked for your establishment and the total number of hours worked.
- ***OSHA's 301: Injury and Illness Incident Report —*** A copy of the OSHA 301 to provide details about the incident. You may make as many copies as you need or use an equivalent form.

Take a few minutes to review this package. If you have any questions, ***visit us online at www.osha. gov*** **or** ***call your local OSHA office.*** We'll be happy to help you.

An Overview: Recording Work-Related Injuries and Illnesses

The Occupational Safety and Health (OSH) Act of 1970 requires certain employers to prepare and maintain records of work-related injuries and illnesses. Use these definitions when you classify cases on the Log. OSHA's recordkeeping regulation (see 29 CFR Part 1904) provides more information about the definitions below.

The *Log of Work-Related Injuries and Illnesses* (Form 300) is used to classify work-related injuries and illnesses and to note the extent and severity of each case. When an incident occurs, use the *Log* to record specific details about what happened and how it happened. The *Summary* — a separate form (Form 300A) — shows the totals for the year in each category. At the end of the year, post the *Summary* in a visible location so that your employees are aware of the injuries and illnesses occurring in their workplace.

Employers must keep a *Log* for each establishment or site. If you have more than one establishment, you must keep a separate *Log* and *Summary* for each physical location that is expected to be in operation for one year or longer.

Note that your employees have the right to review your injury and illness records. For more information, see 29 Code of Federal Regulations Part 1904.35, *Employee Involvement*.

Cases listed on the *Log of Work-Related Injuries and Illnesses* are not necessarily eligible for workers' compensation or other insurance benefits. Listing a case on the *Log* does not mean that the employer or worker was at fault or that an OSHA standard was violated.

When is an injury or illness considered work-related?

An injury or illness is considered work-related if an event or exposure in the work environment caused or contributed to the condition or significantly aggravated a preexisting condition. Work-relatedness is presumed for injuries and illnesses resulting from events or exposures occurring in the workplace, unless an exception specifically applies. See 29 CFR Part 1904.5(b)(2) for the exceptions. The work environment includes the establishment and other locations where one or more employees are working or are present as a condition of their employment. See 29 CFR Part 1904.5(b)(1).

Which work-related injuries and illnesses should you record?

Record those work-related injuries and illnesses that result in:

- death,
- loss of consciousness,
- days away from work,
- restricted work activity or job transfer, or
- medical treatment beyond first aid.

You must also record work-related injuries and illnesses that are significant (as defined below) or meet any of the additional criteria listed below.

You must record any significant work-related injury or illness that is diagnosed by a physician or other licensed health care professional. You must record any work-related case involving cancer, chronic irreversible disease, a fractured or cracked bone, or a punctured eardrum. See 29 CFR 1904.7.

What are the additional criteria?

You must record the following conditions when they are work-related:

- any needlestick injury or cut from a sharp object that is contaminated with another person's blood or other potentially infectious material;
- any case requiring an employee to be medically removed under the requirements of an OSHA health standard;
- tuberculosis infection as evidenced by a positive skin test or diagnosis by a physician or other licensed health care professional after exposure to a known case of active tuberculosis.
- an employee's hearing test (audiogram) reveals 1) that the employee has experienced a Standard Threshold Shift (STS) in hearing in one or both ears (averaged at 2000, 3000, and 4000 Hz) and 2) the employee's total hearing level is 25 decibels (dB) or more above audiometric zero (also averaged at 2000, 3000, and 4000 Hz) in the same ear(s) as the STS.

What is medical treatment?

Medical treatment includes managing and caring for a patient for the purpose of combating disease or disorder. The following are not considered medical treatments and are NOT recordable:

- visits to a doctor or health care professional solely for observation or counseling;

What do you need to do?

1. Within 7 calendar days after you receive information about a case, decide if the case is recordable under the OSHA recordkeeping requirements.
2. Determine whether the incident is a new case or a recurrence of an existing one.
3. Establish whether the case was work-related.
4. If the case is recordable, decide which form you will fill out as the injury and illness incident report.

   You may use *OSHA's 301: Injury and Illness Incident Report* or an equivalent form. Some state workers compensation, insurance, or other reports may be acceptable substitutes, as long as they provide the same information as the OSHA 301.

How to work with the Log

1. Identify the employee involved unless it is a privacy concern case as described below.
2. Identify when and where the case occurred.
3. Describe the case, as specifically as you can.
4. Classify the seriousness of the case by recording the **most serious outcome** associated with the case, with column G (Death) being the most serious and column J (Other recordable cases) being the least serious.
5. Identify whether the case is an injury or illness. If the case is an injury, check the injury category. If the case is an illness, check the appropriate illness category.

U.S. Department of Labor
Occupational Safety and Health Administration

- diagnostic procedures, including administering prescription medications that are used solely for diagnostic purposes; and
- any procedure that can be labeled first aid. (*See below for more information about first aid.*)

What is first aid?

If the incident required only the following types of treatment, consider it first aid. Do NOT record the case if it involves only:

- using non-prescription medications at non-prescription strength;
- administering tetanus immunizations;
- cleaning, flushing, or soaking wounds on the skin surface;
- using wound coverings, such as bandages, BandAids™, gauze pads, etc., or using SteriStrips™ or butterfly bandages.
- using hot or cold therapy;
- using any totally non-rigid means of support, such as elastic bandages, wraps, non-rigid back belts, etc.;
- using temporary immobilization devices while transporting an accident victim (splints, slings, neck collars, or back boards).
- drilling a fingernail or toenail to relieve pressure, or draining fluids from blisters;
- using eye patches;
- using simple irrigation or a cotton swab to remove foreign bodies not embedded in or adhered to the eye;
- using irrigation, tweezers, cotton swab or other simple means to remove splinters or foreign material from areas other than the eye;
- using finger guards;
- using massages;
- drinking fluids to relieve heat stress

How do you decide if the case involved restricted work?

Restricted work activity occurs when, as the result of a work-related injury or illness, an employer or health care professional keeps, or recommends keeping, an employee from doing the routine functions of his or her job or from working the full workday that the employee would have been scheduled to work before the injury or illness occurred.

How do you count the number of days of restricted work activity or the number of days away from work?

Count the number of calendar days the employee was on restricted work activity or was away from work as a result of the recordable injury or illness. Do not count the day on which the injury or illness occurred in this number. Begin counting days from the day after the incident occurs. If a single injury or illness involved both days away from work and days of restricted work activity, enter the total number of days for each. You may stop counting days of restricted work activity or days away from work once the total of either or the combination of both reaches 180 days.

Under what circumstances should you NOT enter the employee's name on the OSHA Form 300?

You must consider the following types of injuries or illnesses to be privacy concern cases:

- an injury or illness to an intimate body part or to the reproductive system,
- an injury or illness resulting from a sexual assault,
- a mental illness,
- a case of HIV infection, hepatitis, or tuberculosis,
- a needlestick injury or cut from a sharp object that is contaminated with blood or other potentially infectious material (see 29 CFR Part 1904.8 for definition), and
- other illnesses, if the employee independently and voluntarily requests that his or her name not be entered on the log.

You must not enter the employee's name on the OSHA 300 *Log* for these cases. Instead, enter "privacy case" in the space normally used for the employee's name. You must keep a separate, confidential list of the case numbers and employee names for the establishment's privacy concern cases so that you can update the cases and provide information to the government if asked to do so.

If you have a reasonable basis to believe that information describing the privacy concern case may be personally identifiable even though the employee's name has been omitted, you may use discretion in describing the injury or illness on both the OSHA 300 and 301 forms. You must enter enough information to identify the cause of the incident and the general severity of the injury or illness, but you do not need to include details of an intimate or private nature.

What if the outcome changes after you record the case?

If the outcome or extent of an injury or illness changes after you have recorded the case, simply draw a line through the original entry or, if you wish, delete or white-out the original entry. Then write the new entry where it belongs. Remember, you need to record the most serious outcome for each case.

Classifying injuries

An injury is any wound or damage to the body resulting from an event in the work environment.

Examples: Cut, puncture, laceration, abrasion, fracture, bruise, contusion, chipped tooth, amputation, insect bite, electrocution, or a thermal, chemical, electrical, or radiation burn. Sprain and strain injuries to muscles, joints, and connective tissues are classified as injuries when they result from a slip, trip, fall or other similar accidents.

U.S. Department of Labor
Occupational Safety and Health Administration

Classifying illnesses

Skin diseases or disorders

Skin diseases or disorders are illnesses involving the worker's skin that are caused by work exposure to chemicals, plants, or other substances.

Examples: Contact dermatitis, eczema, or rash caused by primary irritants and sensitizers or poisonous plants; oil acne; friction blisters, chrome ulcers; inflammation of the skin.

Respiratory conditions

Respiratory conditions are illnesses associated with breathing hazardous biological agents, chemicals, dust, gases, vapors, or fumes at work.

Examples: Silicosis, asbestosis, pneumonitis, pharyngitis, rhinitis or acute congestion; farmer's lung, beryllium disease, tuberculosis, occupational asthma, reactive airways dysfunction syndrome (RADS), chronic obstructive pulmonary disease (COPD), hypersensitivity pneumonitis, toxic inhalation injury, such as metal fume fever, chronic obstructive bronchitis, and other pneumoconioses.

Poisoning

Poisoning includes disorders evidenced by abnormal concentrations of toxic substances in blood, other tissues, other bodily fluids, or the breath that are caused by the ingestion or absorption of toxic substances into the body.

Examples: Poisoning by lead, mercury, cadmium, arsenic, or other metals; poisoning by carbon monoxide, hydrogen sulfide, or other gases; poisoning by benzene, benzol, carbon tetrachloride, or other organic solvents; poisoning by insecticide sprays, such as parathion or lead arsenate; poisoning by other chemicals, such as formaldehyde.

Hearing Loss

Noise-induced hearing loss is defined for recordkeeping purposes as a change in hearing threshold relative to the baseline audiogram of an average of 10 dB or more in either ear at 2000, 3000 and 4000 hertz, and the employee's total hearing level is 25 decibels (dB) or more above audiometric zero (also averaged at 2000, 3000, and 4000 hertz) in the same ear(s).

All other illnesses

All other occupational illnesses.

Examples: Heatstroke, sunstroke, heat exhaustion, heat stress and other effects of environmental heat; freezing, frostbite, and other effects of exposure to low temperatures; decompression sickness; effects of ionizing radiation (isotopes, x-rays, radium); effects of nonionizing radiation (welding flash, ultra-violet rays, lasers); anthrax; bloodborne pathogenic diseases, such as AIDS, HIV, hepatitis B or hepatitis C; brucellosis; malignant or benign tumors; histoplasmosis; coccidioidomycosis.

When must you post the Summary?

You must post the *Summary* only — not the *Log* — by February 1 of the year following the year covered by the form and keep it posted until April 30 of that year.

How long must you keep the Log and Summary on file?

You must keep the *Log* and *Summary* for 5 years following the year to which they pertain.

Do you have to send these forms to OSHA at the end of the year?

No. You do not have to send the completed forms to OSHA unless specifically asked to do so.

How can we help you?

If you have a question about how to fill out the *Log*,

- ❑ ***visit us online at www.osha.gov*** or
- ❑ ***call your local OSHA office.***

Optional

Calculating Injury and Illness Incidence Rates

What is an incidence rate?

An incidence rate is the number of recordable injuries and illnesses occurring among a given number of full-time workers (usually 100 full-time workers) over a given period of time (usually one year). To evaluate your firm's injury and illness experience over time or to compare your firm's experience with that of your industry as a whole, you need to compute your incidence rate. Because a specific number of workers and a specific period of time are involved, these rates can help you identify problems in your workplace and/or progress you may have made in preventing work-related injuries and illnesses.

How do you calculate an incidence rate?

You can compute an occupational injury and illness incidence rate for all recordable cases or for cases that involved days away from work for your firm quickly and easily. The formula requires that you follow instructions in paragraph (a) below for the total recordable cases or those in paragraph (b) for cases that involved days away from work, *and* for both rates the instructions in paragraph (c).

(a) *To find out the total number of recordable injuries and illnesses that occurred during the year,* count the number of line entries on your OSHA Form 300, or refer to the OSHA Form 300A and sum the entries for columns (G), (H), (I), and (J).

(b) *To find out the number of injuries and illnesses that involved days away from work,* count the number of line entries on your OSHA Form 300 that received a check mark in column (H), or refer to the entry for column (H) on the OSHA Form 300A.

(c) *The number of hours all employees actually worked during the year*. Refer to OSHA Form 300A and optional worksheet to calculate this number.

You can compute the incidence rate for all recordable cases of injuries and illnesses using the following formula:

Total number of injuries and illnesses x *200,000* ÷ *Number of hours worked by all employees = Total recordable case rate*

(The 200,000 figure in the formula represents the number of hours 100 employees working 40 hours per week, 50 weeks per year would work, and provides the standard base for calculating incidence rates.)

You can compute the incidence rate for recordable cases involving days away from work, days of restricted work activity or job transfer (DART) using the following formula:

(Number of entries in column H + Number of entries in column I) x *200,000* ÷ *Number of hours worked by all employees = DART incidence rate*

You can use the same formula to calculate incidence rates for other variables such as cases involving restricted work activity (column (I) on Form 300A), cases involving skin disorders (column (M-2) on Form 300A), etc. Just substitute the appropriate total for these cases, from Form 300A, into the formula in place of the total number of injuries and illnesses.

What can I compare my incidence rate to?

The Bureau of Labor Statistics (BLS) conducts a survey of occupational injuries and illnesses each year and publishes incidence rate data by various classifications (e.g., by industry, by employer size, etc.). You can obtain these published data at www.bls.gov/iif or by calling a BLS Regional Office.

Worksheet

Total number of injuries and illnesses			Number of hours worked by all employees		Total recordable case rate
	x 200,000	÷		=	

Number of entries in Column H + Column I			Number of hours worked by all employees		DART incidence rate
	x 200,000	÷		=	

U.S. Department of Labor
Occupational Safety and Health Administration

How to Fill Out the Log

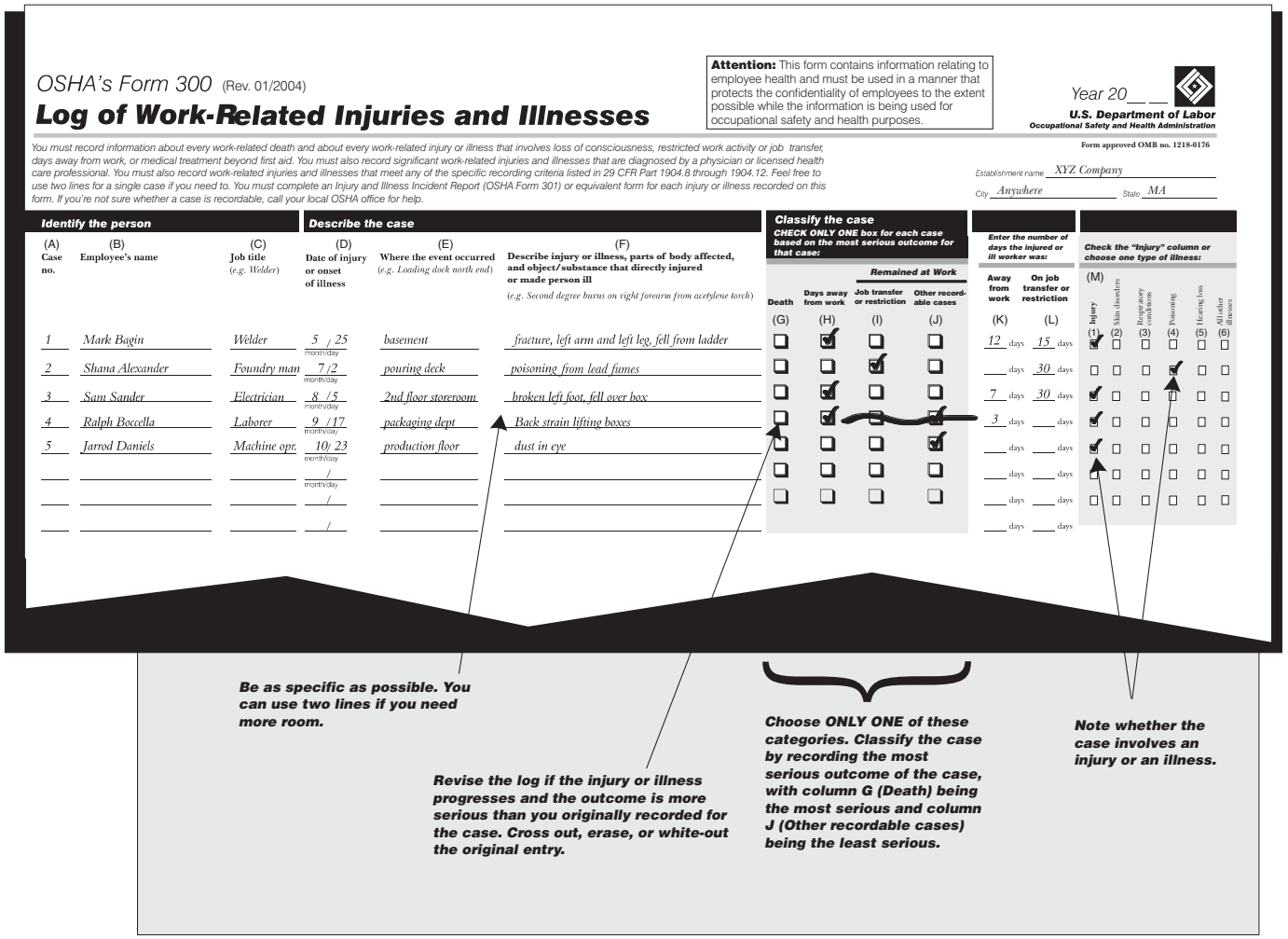
The *Log of Work-Related Injuries and Illnesses* is used to classify work-related injuries and illnesses and to note the extent and severity of each case. When an incident occurs, use the *Log* to record specific details about what happened and how it happened.

If your company has more than one establishment or site, you must keep separate records for each physical location that is expected to remain in operation for one year or longer.

We have given you several copies of the *Log* in this package. If you need more than we provided, you may photocopy and use as many as you need.

The *Summary* — a separate form — shows the work-related injury and illness totals for the year in each category. At the end of the year, count the number of incidents in each category and transfer the totals from the *Log* to the *Summary.* Then post the *Summary* in a visible location so that your employees are aware of injuries and illnesses occurring in their workplace.

You don't post the Log. You post only the Summary at the end of the year.



OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Year 20__ __

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR Part 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an Injury and Illness Incident Report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name XYZ Company
City Anywhere State MA

Identify the person			Describe the case			Classify the case (CHECK ONLY ONE box for each case based on the most serious outcome for that case:)				Enter the number of days the injured or ill worker was:		Check the "Injury" column or choose one type of illness:					
(A) Case no.	(B) Employee's name	(C) Job title (e.g. Welder)	(D) Date of injury or onset of illness	(E) Where the event occurred (e.g. Loading dock north end)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (e.g. Second degree burns on right forearm from acetylene torch)	(G) Death	(H) Days away from work	(I) Job transfer or restriction	(J) Other recordable cases	(K) Away from work	(L) On job transfer or restriction	(M) (1) Injury	(2) Skin disorders	(3) Respiratory conditions	(4) Poisoning	(5) Hearing loss	(6) All other illnesses
1	Mark Bagin	Welder	5/25	basement	fracture, left arm and left leg, fell from ladder	☐	☑	☐	☐	12 days	15 days	☑	☐	☐	☐	☐	☐
2	Shana Alexander	Foundry man	7/2	pouring deck	poisoning from lead fumes	☐	☐	☑	☐	___ days	30 days	☐	☐	☐	☑	☐	☐
3	Sam Sander	Electrician	8/5	2nd floor storeroom	broken left foot, fell over box	☐	☑	☐	☐	7 days	30 days	☑	☐	☐	☐	☐	☐
4	Ralph Boccella	Laborer	9/17	packaging dept	Back strain lifting boxes	☐	☑	☐	☐	3 days	___ days	☑	☐	☐	☐	☐	☐
5	Jarrod Daniels	Machine opr.	10/23	production floor	dust in eye	☐	☐	☐	☑	___ days	___ days	☑	☐	☐	☐	☐	☐
			/			☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
			/			☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
			/			☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐

Be as specific as possible. You can use two lines if you need more room.

Revise the log if the injury or illness progresses and the outcome is more serious than you originally recorded for the case. Cross out, erase, or white-out the original entry.

Choose ONLY ONE of these categories. Classify the case by recording the most serious outcome of the case, with column G (Death) being the most serious and column J (Other recordable cases) being the least serious.

Note whether the case involves an injury or an illness.

OSHA's Form 300 (Rev. 01/2004)

Log of Work-Related Injuries and Illnesses

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

Year 20__ __

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

You must record information about every work-related death and about every work-related injury or illness that involves loss of consciousness, restricted work activity or job transfer, days away from work, or medical treatment beyond first aid. You must also record significant work-related injuries and illnesses that are diagnosed by a physician or licensed health care professional. You must also record work-related injuries and illnesses that meet any of the specific recording criteria listed in 29 CFR Part 1904.8 through 1904.12. Feel free to use two lines for a single case if you need to. You must complete an Injury and Illness Incident Report (OSHA Form 301) or equivalent form for each injury or illness recorded on this form. If you're not sure whether a case is recordable, call your local OSHA office for help.

Establishment name ______________________

City ______________ *State* ________

Identify the person			Describe the case			Classify the case: CHECK ONLY ONE box for each case based on the most serious outcome for that case:				Enter the number of days the injured or ill worker was:		Check the "Injury" column or choose one type of illness: (M)					
(A) Case no.	(B) Employee's name	(C) Job title (*e.g., Welder*)	(D) Date of injury or onset of illness	(E) Where the event occurred (*e.g., Loading dock north end*)	(F) Describe injury or illness, parts of body affected, and object/substance that directly injured or made person ill (*e.g., Second degree burns on right forearm from acetylene torch*)	Death (G)	Days away from work (H)	Remained at Work: Job transfer or restriction (I)	Remained at Work: Other record-able cases (J)	Away from work (K)	On job transfer or restriction (L)	Injury (1)	Skin disorder (2)	Respiratory condition (3)	Poisoning (4)	Hearing loss (5)	All other illnesses (6)
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
____	____	____	___/___ month/day	____	____	☐	☐	☐	☐	___ days	___ days	☐	☐	☐	☐	☐	☐
					Page totals ➤	____	____	____	____	____	____	____	____	____	____	____	____
												Injury (1)	Skin disorder (2)	Respiratory condition (3)	Poisoning (4)	Hearing loss (5)	All other illnesses (6)

Be sure to transfer these totals to the Summary page (Form 300A) before you post it.

Page ___ of ___

OSHA's Form 300A (Rev. 01/2004)

Summary of Work-Related Injuries and Illnesses

Year 20__ __

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

All establishments covered by Part 1904 must complete this Summary page, even if no work-related injuries or illnesses occurred during the year. Remember to review the Log to verify that the entries are complete and accurate before completing this summary.

Using the Log, count the individual entries you made for each category. Then write the totals below, making sure you've added the entries from every page of the Log. If you had no cases, write "0."

Employees, former employees, and their representatives have the right to review the OSHA Form 300 in its entirety. They also have limited access to the OSHA Form 301 or its equivalent. See 29 CFR Part 1904.35, in OSHA's recordkeeping rule, for further details on the access provisions for these forms.

Number of Cases

Total number of deaths	Total number of cases with days away from work	Total number of cases with job transfer or restriction	Total number of other recordable cases
_____	_____	_____	_____
(G)	(H)	(I)	(J)

Number of Days

Total number of days away from work	Total number of days of job transfer or restriction
_____	_____
(K)	(L)

Injury and Illness Types

Total number of . . . (M)

(1) Injuries _____
(2) Skin disorders _____
(3) Respiratory conditions _____
(4) Poisonings _____
(5) Hearing loss _____
(6) All other illnesses _____

Post this Summary page from February 1 to April 30 of the year following the year covered by the form.

Establishment information

Your establishment name _____

Street _____

City _____ State _____ ZIP _____

Industry description (*e.g., Manufacture of motor truck trailers*)

_____

Standard Industrial Classification (SIC), if known (*e.g., 3715*)

____ ____ ____ ____

OR

North American Industrial Classification (NAICS), if known (e.g., 336212)

____ ____ ____ ____ ____ ____

Employment information *(If you don't have these figures, see the Worksheet on the back of this page to estimate.)*

Annual average number of employees _____

Total hours worked by all employees last year _____

Sign here

Knowingly falsifying this document may result in a fine.

I certify that I have examined this document and that to the best of my knowledge the entries are true, accurate, and complete.

_____ _____
Company executive Title

( ) - / /
Phone Date

Optional

Worksheet to Help You Fill Out the Summary

At the end of the year, OSHA requires you to enter the average number of employees and the total hours worked by your employees on the summary. If you don't have these figures, you can use the information on this page to estimate the numbers you will need to enter on the Summary page at the end of the year.

How to figure the average number of employees who worked for your establishment during the year:

❶ ***Add*** the total number of employees your establishment paid in all pay periods during the year. Include all employees: full-time, part-time, temporary, seasonal, salaried, and hourly.

The number of employees paid in all pay periods = ❶ _____

❷ ***Count*** the number of pay periods your establishment had during the year. Be sure to include any pay periods when you had no employees.

The number of pay periods during the year = ❷ _____

❸ ***Divide*** the number of employees by the number of pay periods.

❶ / ❷ _____ = ❸ _____

❹ ***Round the answer*** to the next highest whole number. Write the rounded number in the blank marked *Annual average number of employees*.

The number rounded = ❹ _____

For example, Acme Construction figured its average employment this way:

For pay period...	**Acme paid this number of employees...**
1	10
2	0
3	15
4	30
5	40
▼	▼
24	20
25	15
26	+10
	830

Number of employees paid = 830 ❶

Number of pay periods = 26 ❷

830 / 26 = 31.92 ❸

31.92 rounds to 32 ❹

32 is the annual average number of employees

How to figure the total hours worked by all employees:

Include hours worked by salaried, hourly, part-time and seasonal workers, as well as hours worked by other workers subject to day to day supervision by your establishment (e.g., temporary help services workers).

Do not include vacation, sick leave, holidays, or any other non-work time, even if employees were paid for it. If your establishment keeps records of only the hours paid or if you have employees who are not paid by the hour, please estimate the hours that the employees actually worked.

If this number isn't available, you can use this optional worksheet to estimate it.

Optional Worksheet

_____ ***Find*** the number of full-time employees in your establishment for the year.

X _____ ***Multiply*** by the number of work hours for a full-time employee in a year.

_____ This is the number of full-time hours worked.

\+ _____ ***Add*** the number of any overtime hours as well as the hours worked by other employees (part-time, temporary, seasonal)

_____ ***Round*** the answer to the next highest whole number. Write the rounded number in the blank marked *Total hours worked by all employees last year.*

U.S. Department of Labor
Occupational Safety and Health Administration

OSHA's Form 301
Injury and Illness Incident Report

Attention: This form contains information relating to employee health and must be used in a manner that protects the confidentiality of employees to the extent possible while the information is being used for occupational safety and health purposes.

U.S. Department of Labor
Occupational Safety and Health Administration

Form approved OMB no. 1218-0176

This *Injury and Illness Incident Report* is one of the first forms you must fill out when a recordable work-related injury or illness has occurred. Together with the *Log of Work-Related Injuries and Illnesses* and the accompanying *Summary,* these forms help the employer and OSHA develop a picture of the extent and severity of work-related incidents.

Within 7 calendar days after you receive information that a recordable work-related injury or illness has occurred, you must fill out this form or an equivalent. Some state workers' compensation, insurance, or other reports may be acceptable substitutes. To be considered an equivalent form, any substitute must contain all the information asked for on this form.

According to Public Law 91-596 and 29 CFR 1904, OSHA's recordkeeping rule, you must keep this form on file for 5 years following the year to which it pertains.

If you need additional copies of this form, you may photocopy and use as many as you need.

Completed by _____

Title _____

Phone (_____)_____--_____ **Date** ____/ ____/ ____

Information about the employee

1) **Full name** _____

2) **Street** _____

City _____ **State** _____ **ZIP** _____

3) **Date of birth** _____ / _____ / _____

4) **Date hired** _____ / _____ / _____

5) ❒ **Male**
❒ **Female**

Information about the physician or other health care professional

6) **Name of physician or other health care professional** _____

_____

7) **If treatment was given away from the worksite, where was it given?**

Facility _____

Street _____

City _____ **State** _____ **ZIP** _____

8) **Was employee treated in an emergency room?**
❒ **Yes**
❒ **No**

9) **Was employee hospitalized overnight as an in-patient?**
❒ **Yes**
❒ **No**

Information about the case

10) **Case number from the *Log*** _____ *(Transfer the case number from the Log after you record the case.)*

11) **Date of injury or illness** _____ / _____ / _____

12) **Time employee began work** _____ **AM / PM**

13) **Time of event** _____ **AM / PM** ☐ **Check if time cannot be determined**

14) ***What was the employee doing just before the incident occurred?*** **Describe the activity, as well as the tools, equipment, or material the employee was using. Be specific.** ***Examples:*** **"climbing a ladder while carrying roofing materials"; "spraying chlorine from hand sprayer"; "daily computer key-entry."**

15) ***What happened?*** **Tell us how the injury occurred.** ***Examples:*** **"When ladder slipped on wet floor, worker fell 20 feet"; "Worker was sprayed with chlorine when gasket broke during replacement"; "Worker developed soreness in wrist over time."**

16) ***What was the injury or illness?*** **Tell us the part of the body that was affected and how it was affected; be more specific than "hurt," "pain," or sore."** ***Examples:*** **"strained back"; "chemical burn, hand"; "carpal tunnel syndrome."**

17) ***What object or substance directly harmed the employee?*** ***Examples:*** **"concrete floor"; "chlorine"; "radial arm saw."** ***If this question does not apply to the incident, leave it blank.***

18) ***If the employee died, when did death occur?*** **Date of death** _____ / _____ / _____

If You Need Help...

If you need help deciding whether a case is recordable, or if you have questions about the information in this package, feel free to contact us. We'll gladly answer any questions you have.

- **Visit us online at www.osha.gov**
- **Call your OSHA Regional office and ask for the recordkeeping coordinator**

  or

- **Call your State Plan office**

U.S. Department of Labor
Occupational Safety and Health Administration

Federal Jurisdiction

Region 1 - 617 / 565-9860
Connecticut; Massachusetts; Maine; New Hampshire; Rhode Island

Region 2 - 212 / 337-2378
New York; New Jersey

Region 3 - 215 / 861-4900
DC; Delaware; Pennsylvania; West Virginia

Region 4 - 404 / 562-2300
Alabama; Florida; Georgia; Mississippi

Region 5 - 312 / 353-2220
Illinois; Ohio; Wisconsin

Region 6 - 214 / 767-4731
Arkansas; Louisiana; Oklahoma; Texas

Region 7 - 816 / 426-5861
Kansas; Missouri; Nebraska

Region 8 - 303 / 844-1600
Colorado; Montana; North Dakota; South Dakota

Region 9 - 415 / 975-4310

Region 10 - 206 / 553-5930
Idaho

State Plan States

Alaska - 907 / 269-4957

Arizona - 602 / 542-5795

California - 415 / 703-5100

*Connecticut - 860 / 566-4380

Hawaii - 808 / 586-9100

Indiana - 317 / 232-2688

Iowa - 515 / 281-3661

Kentucky - 502 / 564-3070

Maryland - 410 / 767-2371

Michigan - 517 / 322-1848

Minnesota - 651 / 284-5050

Nevada - 702 / 486-9020

*New Jersey - 609 / 984-1389

New Mexico - 505 / 827-4230

*New York - 518 / 457-2574

North Carolina - 919 / 807-2875

Oregon - 503 / 378-3272

Puerto Rico - 787 / 754-2172

South Carolina - 803 / 734-9669

Tennessee - 615 / 741-2793

Utah - 801 / 530-6901

Vermont - 802 / 828-2765

Virginia - 804 / 786-6613

Virgin Islands - 340 / 772-1315

Washington - 360 / 902-5554

Wyoming - 307 / 777-7786

*Public Sector only

U.S. Department of Labor
Occupational Safety and Health Administration

Have questions?

If you need help in filling out the *Log* or *Summary,* or if you have questions about whether a case is recordable, contact us. We'll be happy to help you. You can:

- Visit us online at: **www.osha.gov**
- Call your regional or state plan office. You'll find the phone number listed inside this cover.

Laboratory Safety
The OSHA Laboratory Standard and the Chemical Hygiene Plan

1. Powerpoint Presentation
    a. Introduction, Class Format
    b. Scope and Application
    c. Definitions
    d. Elements Required by Standard
        i. Exposure Determination
        ii. Chemical Hygiene Plan
        iii. Employee Information
        iv. Employee Training
        v. Medical Consultation and Exams
        vi. Hazard Identification
        vii. Use of Respirators
        viii. Recordkeeping
    e. The Chemical Hygiene Plan
    f. Implementation
        i. Begin with the End in Mind
        ii. Identify Barriers
        iii. Alignment with Company Goals
        iv. Administrative Support
        v. Audits
        vi. Engineering / Facilities Issues
        vii. Exposure Monitoring
        viii. Medical Surveillance

2. Supplemental Information Handouts
    a. 29 CFR 1910.1450 and Appendices
    b. Lab Standard Implementation Survey Forms
    c. Sample Administrative Documents
        i. Administrative Directive
        ii. Administrative Implementation Progress Report

Web Information

OSU Environmental Health and Safety: http://www.ehs.ohio-state.edu/
OSU Dept. of Chemistry Safety Page: http://www.chemistry.ohio-state.edu/ehs/
OSHA Recordkeeping Page: http://www.osha.gov/recordkeeping/index.html
BWC Division of Safety & Hygiene Training Center:
http://www.bwc.state.oh.us/employer/programs/safety/SandHEducation.asp
American National Standards Institute: http://www.ansi.org/

Recommended Reading

Prudent Practices in the Laboratory: Handling and Disposal of Chemicals, NAS, 1995
Safety in Academic Chemistry Laboratories, ACS, 2003
CRC Handbook of Laboratory Safety 5th Edition
Laboratory Health and Safety Handbook, Stricoff and Waters, 1990

The OSHA Laboratory Standard

Tim Govenor, CSP, CIH
Institutional Chemical Hygiene Officer

The Ohio State University

Govenor.1@osu.edu

The OSHA Laboratory Standard

- CFR 1910.1450: Occupational Exposure to Hazardous Chemicals in Laboratories
  - Came from the Hazard Communication Standard
  - Established in 1990
  - State Agencies (H.B. 308) July 1994

The OSHA Laboratory Standard

- Scope and Application
  - Does not apply to Laboratory uses of hazardous materials in which there is no chance for exposure (such as kits).
  - Chemical manipulations are carried out on a "laboratory scale" (one person with small containers).
  - Not part of a production process.

The OSHA Laboratory Standard

- Definitions
  - "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 OSHA Laboratory Standard

- Definitions (1910.1200)
  - "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.

The OSHA Laboratory Standard

- Definitions (1910.1200)
  - "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.

The OSHA Laboratory Standard

- Performance Standard
  - 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 (PEL's) specified in 29 CFR 1910, subpart Z.

The OSHA Laboratory Standard

- Employee Exposure Determination
  - Initial Monitoring
    - If above action level or PEL
  - Periodic Monitoring
    - If initial monitoring warrants
  - Employee Notification of Monitoring
    - Within 15 days
    - In writing

The OSHA Laboratory Standard

- The Chemical Hygiene Plan (CHP)
- Employee Information
  - Must be apprised of chemical hazards
  - Prior to work
  - New procedures/hazards
  - Include the Standard, CHP Location, and the PEL's of the substances
    - If no PEL, then signs and symptoms of exposure and location of reference material and MSDS's

The OSHA Laboratory Standard

- Employee Training
  - Methods and observations that may be used to detect hazards
  - Physical and health hazards
  - Measures used to protect themselves
    - SOP's
    - Emergency Procedures
    - PPE
  - Applicable Details of the CHP

The OSHA Laboratory Standard

- Medical Consultation and Examinations
  - Medical Attention and Follow-Up Exams will be provided when
    - Signs and symptoms
    - Monitoring reveals routine exposure above action level or PEL
    - Accident/Spill/Leak
  - Exams by a Licensed Physician without cost or loss of pay at a reasonable time and place

The OSHA Laboratory Standard

- Medical Consultation and Examinations
  - Information Provided to the Physician
    - Chemical Identity
    - Exposure Conditions
    - Signs and Symptoms
  - Written Opinion
    - Recommendation for follow-up
    - Results of any tests
    - Employee has been informed by the physician
    - Shall not reveal specific findings unrelated to the occupational exposure

The OSHA Laboratory Standard

- Hazard Identification
  - Labels shall not be removed or defaced
  - MSDS's shall be maintained and accessible
  - For Chemicals Developed in the Laboratory
    - The employer shall determine the hazard
    - Provide appropriate training
  - Follow Hazard Communication Standard (1910.1200) with respect to MSDS's and Labeling
- Use of Respirators
  - In accordance with the Respiratory Standard (1910.134)

The OSHA Laboratory Standard

- Recordkeeping
  - Medical/Exposure
  - In accordance with 1910.20
  - 30 Years
  - Training
  - 3 years (BBP)

The OSHA Laboratory Standard

The Chemical Hygiene Plan

Shall be capable of

- Protecting employees from health hazards
- Keeping exposures below PEL or action limit
- Being readily available to employees

The OSHA Laboratory Standard

The Chemical Hygiene Plan

- Shall include
  - SOP's
  - Control Measures using
    - Engineering Controls
    - Administrative Controls
    - PPE

The OSHA Laboratory Standard

The Chemical Hygiene Plan

- Shall include
  - Fume Hood Performance measures
  - Information and training
  - Prior Approvals for certain operations
  - Provisions for medical consultations
  - Designation of Personnel that Implement CHP
    - Chemical Hygiene Officer
    - Chemical Hygiene Committee

The OSHA Laboratory Standard

The Chemical Hygiene Plan

- Shall include
  - Provisions for Additional Protection in working with Select Carcinogens, Reproductive Toxins, and Acutely Hazardous Materials
    - Establishment of a Designated Area
    - Use of Containment Devices such fume hoods and glove boxes
    - Procedures for the safe removal of waste
    - Decontamination Procedures

The OSHA Laboratory Standard

Implementation

- Begin with the end in mind.
  - What will successful implementation look like?
  - How will you determine (measure) success?
  - Is it worth doing?
  - Who is going to do it?

The OSHA Laboratory Standard

Implementation

Identify barriers

- It is only safety stuff
- Resistance to change
- Denial
- OK but not me
- I don't have time for this
- Rewards and Consequences
- Ignorance

The OSHA Laboratory Standard

Implementation

Focus on alignment with company goals and values:

- Cost of implementation-$
- Cost of doing nothing-$$$$
- Avoid Civil and Criminal offences
- Potential savings Workers' Compensation
- Potential savings hazardous waste, emergency response,
- Business integrity
- Professional competency

The OSHA Laboratory Standard

Implementation

Administrative support and involvement

Without involvement there is no commitment. Mark it down, asterisk it, circle it, underline it.

No involvement, no commitment.

--Covey

The OSHA Laboratory Standard

Implementation

Where do we stand?

- Market, market, market (educational rule of three).
- Administrative level, grass roots level.
- Verbal, memo, newsletter, courtesy audit.

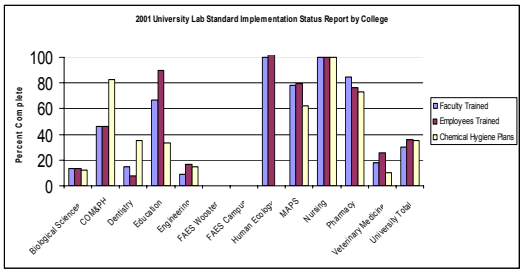
The OSHA Laboratory Standard

Implementation

Initial Audit

- Keep it simple
- What is really important to know
- Involve everyone

The OSHA Laboratory Standard

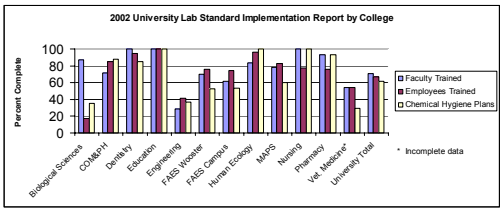


The OSHA Laboratory Standard

Implementation

Make it as "painless" as possible
- Boilerplate document
- Common SOP's
- Forms for chemical inventory, training records
- Internet access
- Customer service
- Implementation guidelines (What do I have to do?)
- Provide general training (keep it short)

The OSHA Laboratory Standard

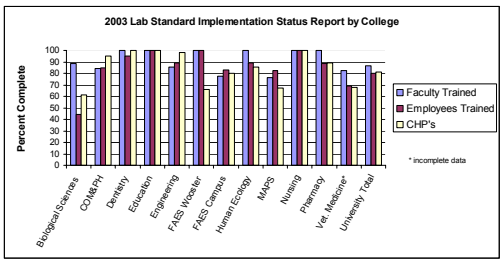


The OSHA Laboratory Standard

Implementation

Accentuate the positive
- Recognize achievers
- Report positive statistics
- Report and communicate progress
- Assist the willing, ignore the others
- Let Administration deal with the unconvinced

The OSHA Laboratory Standard



The OSHA Laboratory Standard

Implementation

Fine tuning
- Field audits
- Training records
- Shift from catch-up to keep-up
- Maintain momentum
- Inspections

The OSHA Laboratory Standard

- Implementation
  - Hood Maintenance, repair
  - Hood Flow monitoring devices
  - Shower eye wash maintenance
  - Equipment
    - PPE, Storage cabinets, spill kits
  - Floor Plans

The OSHA Laboratory Standard

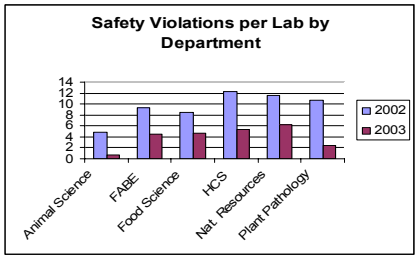
Implementation

Exposure monitoring
- "Reason to believe"
  - Odor threshold<PEL
  - Signs or symptoms
  - Spills, accidents
  - Random direct measurement

Medical Surveillance

The OSHA Laboratory Standard

Inspections



The OSHA Laboratory Standard

Resources

Laboratory Health and Safety Handbook
R.Scott Stricoff and Douglas B. Waters
CRC Handbook of Laboratory Safety
Keith Furr
Prudent Practices in the Laboratory
National Academy Press

The OSHA Laboratory Standard

Questions?

U.S. Department of Labor
Occupational Safety & Health Administration

Regulations (Standards - 29 CFR) - Table of Contents
- Part Number: 1910
- Part Title: Occupational Safety and Health Standards
- Subpart: Z
- Subpart Title: Toxic and Hazardous Substances
- Standard Number: 1910.1450
- Title: Occupational exposure to hazardous chemicals in laboratories.
- Appendix: A, B

1910.1450(a)
Scope and application.
1910.1450(a)(1)
This section shall apply to all employers engaged in the laboratory use of hazardous chemicals as defined below.
1910.1450(a)(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:
1910.1450(a)(2)(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.
1910.1450(a)(2)(ii)
Prohibition of eye and skin contact where specified by any OSHA health standard shall be observed.
1910.1450(a)(2)(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.
1910.1450(a)(3)
This section shall not apply to:
..1910.1450(a)(3)(i)
1910.1450(a)(3)(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.
1910.1450(a)(3)(ii)
Laboratory uses of hazardous chemicals which provide no potential for employee exposure. Examples of such conditions might include:
1910.1450(a)(3)(ii)(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

1910.1450(a)(3)(ii)(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.

1910.1450(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 deg. F (37.8 deg. C), but below 200 deg. F (93.3 deg. C), except any mixture having components with flashpoints of 200 deg. F (93.3 deg. C), or higher, the total volume of which make up 99 percent or more of the total volume of the mixture.

Compressed gas means:

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

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

(iii) A liquid having a vapor pressure exceeding 40 psi at 100 deg. F (37.8 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 deg F (37.8 deg. C), except any mixture having components with flashpoints of 100 deg. C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

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

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

(i) Tagliabue Closed Tester (See American National Standard Method of Test for Flash Point by Tag Closed Tester, Z11.24 - 1979 (ASTM D 56-79)) - for liquids with a

viscosity of less than 45 Saybolt Universal Seconds (SUS) at 100 deg. F (37.8 deg. C), that do not contain suspended solids and do not have a tendency to form a surface film under test; or

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

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

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

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, 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 safety 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 movable 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 tat 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 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 mg/m(3);

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

(C) After oral dosages of less than 50 mg/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.

1910.1450(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.

1910.1450(d)

Employee exposure determination --

1910.1450(d)(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).

1910.1450(d)(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.

1910.1450(d)(3)

Termination of monitoring. Monitoring may be terminated in accordance with the relevant standard.

1910.1450(d)(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.

1910.1450(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).

1910.1450(e)(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:

1910.1450(e)(1)(i)

Capable of protecting employees from health hazards associated with hazardous chemicals in that laboratory and

1910.1450(e)(1)(ii)

Capable of keeping exposures below the limits specified in paragraph (c) of this section.

1910.1450(e)(2)

The Chemical Hygiene Plan shall be readily available to employees, employee representatives and, upon request, to the Assistant Secretary.

1910.1450(e)(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;

1910.1450(e)(3)(i)

Standard operating procedures relevant to safety and health considerations to be followed when laboratory work involves the use of hazardous chemicals;

1910.1450(e)(3)(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;

1910.1450(e)(3)(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;

1910.1450(e)(3)(iv)

Provisions for employee information and training as prescribed in paragraph (f) of this section;

1910.1450(e)(3)(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;

1910.1450(e)(3)(vi)

Provisions for medical consultation and medical examinations in accordance with paragraph (g) of this section;

1910.1450(e)(3)(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
1910.1450(e)(3)(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:
1910.1450(e)(3)(viii)(A)
Establishment of a designated area;
1910.1450(e)(3)(viii)(B)
Use of containment devices such as fume hoods or glove boxes;
1910.1450(e)(3)(viii)(C)
Procedures for safe removal of contaminated waste; and
1910.1450(e)(3)(viii)(D)
Decontamination procedures.
1910.1450(e)(4)
The employer shall review and evaluate the effectiveness of the Chemical Hygiene Plan at least annually and update it as necessary.
1910.1450(f)
Employee information and training.
1910.1450(f)(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.
1910.1450(f)(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.
1910.1450(f)(3)
Information. Employees shall be informed of:
1910.1450(f)(3)(i)
The contents of this standard and its appendices which shall be made available to employees;
1910.1450(f)(3)(ii)
the location and availability of the employer's Chemical Hygiene Plan;
1910.1450(f)(3)(iii)
The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard;
1910.1450(f)(3)(iv)
Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory; and

1910.1450(f)(3)(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.
1910.1450(f)(4)
Training.
1910.1450(f)(4)(i)
Employee training shall include:
1910.1450(f)(4)(i)(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.);
1910.1450(f)(4)(i)(B)
The physical and health hazards of chemicals in the work area; and
1910.1450(f)(4)(i)(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.
1910.1450(f)(4)(ii)
The employee shall be trained on the applicable details of the employer's written Chemical Hygiene Plan.
1910.1450(g)
Medical consultation and medical examinations.
1910.1450(g)(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:
1910.1450(g)(1)(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.
1910.1450(g)(1)(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.
1910.1450(g)(1)(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.

1910.1450(g)(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.

1910.1450(g)(3)

Information provided to the physician. The employer shall provide the following information to the physician:

1910.1450(g)(3)(i)

The identity of the hazardous chemical(s) to which the employee may have been exposed;

1910.1450(g)(3)(ii)

A description of the conditions under which the exposure occurred including quantitative exposure data, if available; and

1910.1450(g)(3)(iii)

A description of the signs and symptoms of exposure that the employee is experiencing, if any.

1910.1450(g)(4)

Physician's written opinion.

1910.1450(g)(4)(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:

1910.1450(g)(4)(i)(A)

Any recommendation for further medical follow-up;

1910.1450(g)(4)(i)(B)

The results of the medical examination and any associated tests;

1910.1450(g)(4)(i)(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 workplace; and

1910.1450(g)(4)(i)(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.

1910.1450(g)(4)(ii)

The written opinion shall not reveal specific findings of diagnoses unrelated to occupational exposure.

1910.1450(h)

Hazard identification.

1910.1450(h)(1)

With respect to labels and material safety data sheets:

1910.1450(h)(1)(i)

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

1910.1450(h)(1)(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.

1910.1450(h)(2)
The following provisions shall apply to chemical substances developed in the laboratory:

1910.1450(h)(2)(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.

1910.1450(h)(2)(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.

1910.1450(h)(2)(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.

1910.1450(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.

1910.1450(j)
Recordkeeping.

1910.1450(j)(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.

1910.1450(j)(2)
The employer shall assure that such records are kept, transferred, and made available in accordance with 29 CFR 1910.1020.

1910.1450(k)
Dates --

1910.1450(k)(1)
Effective date. This section shall become effective May 1, 1990.

1910.1450(k)(2)
Start-up dates.

1910.1450(k)(2)(i)
Employers shall have developed and implemented a written Chemical Hygiene Plan no later than January 31, 1991.

1910.1450(k)(2)(ii)
Paragraph (a)(2) of this section shall not take effect until the employer has developed and implemented a written Chemical Hygiene Plan.

1910.1450(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.

[55 FR 3327, Jan. 31, 1990; 55 FR 7967, March, 6, 1990; 55 FR 12777, March 30, 1990; 61 FR 5507, Feb. 13, 1996]

National Research Council Recommendations Concerning Chemical Hygiene in Laboratories (Non-Mandatory) - 1910.1450 Appendix A

Regulations (Standards - 29 CFR) - Table of Contents

- Part Number: 1910
- Part Title: Occupational Safety and Health Standards
- Subpart: Z
- Subpart Title: Toxic and Hazardous Substances
- Standard Number: 1910.1450 App A
- Title: National Research Council Recommendations Concerning Chemical Hygiene in Laboratories (Non-Mandatory)

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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 form "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" deal 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.

Corresponding Sections of the Standard and this Appendix

The following table is given for the convenience of those who are developing a Chemical Hygiene Plan which will satisfy the requirements of paragraph (e) of the standard. It indicates those sections of this appendix which are most pertinent to each of the sections of paragraph (e) and related paragraphs.

Paragraph and topic in laboratory standard	Relevant appendix section
(e)(3)(i) Standard operating procedures for handling toxic chemicals.	C, D, E
(e)(3)(ii) Criteria to be used for implementation of measures to reduce exposures.	D
(e)(3)(iii) Fume hood performance	C4b

(e)(3)(iv) Employee information and training (including emergency procedures).	D10, D9
(e)(3)(v) Requirements for prior approval of laboratory activities.	E2b, E4b
(e)(3)(vi) Medical consultation and medical examinations.	D5, E4f
(e)(3)(vii) Chemical hygiene responsibilities.	B
(e)(3)(viii) Special precautions for work with particularly hazardous substances.	E2, E3, E4

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 continual 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). 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: diisopropylfluorophosphate (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 revent 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, 162-64, 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)
Acrylonitrile
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)

References (Non-Mandatory) - 1910.1450 App B

Regulations (Standards - 29 CFR) - Table of Contents
- Part Number: 1910
- Part Title: Occupational Safety and Health Standards
- Subpart: Z
- Subpart Title: Toxic and Hazardous Substances
- Standard Number: 1910.1450 App B
- Title: 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.

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 US. 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.

[55 FR 3327, Jan. 31, 1990; 57 FR 29204, July 1, 1992; 61 FR 5507, Feb. 13, 1996]

Complete and return copies to your department Chairman and OEHS by April 4, 2003.

Faculty and Principal Investigator Lab Standard Survey Form

Date: _____

Department: _____

Name: _____

Title: _____

Phone: _____ Email: _____

1. Have you received Lab Standard Training at OSU? (circle one) Yes No
2. Who trained you? _____
3. How many Laboratory Rooms (4 walls) does your research group occupy? _____
   List building and room numbers:
   _____
   _____
   _____
4. Does your group have a written, completed, current (completed or revised within one year) Chemical Hygiene Plan? (circle one) Yes No
5. How many lab employees are in your research group (head count)? _____
6. How many lab employees have received Lab Standard Training at OSU? _____
7. Who trained your lab employees?
   _____
   _____
8. How many lab related injuries or illnesses occurred in your group in 2002?

   _____
9. How many workdays were lost (count full days employees could not return to work) due to lab related injuries or illnesses in 2002?

   _____

OEHS, 1314 Kinnear Road Rm 210, CAMPUS

Complete and return copies to your Dean and OEHS by April 18, 2003

Department Summary Form Date:_____
Lab Standard Survey

Department: _____

Department Chairman: _____

Department Chemical Hygiene Officer or
Chemical Hygiene Committee Chairman: _____

1. Number (head count) of Faculty with affected Laboratories _____

2. Number of Faculty who have received Lab Standard Training at OSU?
   Answered Yes to #1 Faculty And Principal Investigator Lab Standard Survey Form _____

3. Number of Laboratory rooms:
   Sum of #3 Faculty and Principal Investigator Lab Standard Survey Form _____

4. Number of Faculty research groups with completed Chemical Hygiene Plans?
   Answered Yes to #4 Faculty and Principal Investigator Lab Standard Survey Form _____

5. Number (head count) of affected Lab Employees (exclude faculty)?
   Sum of #5 Faculty and Principal Investigator Lab Standard Survey Form _____

6. Number (head count) of affected Lab Employees (exclude faculty) who have received Lab Standard Training at OSU?
   Sum of #6 Faculty and Principal Investigator Lab Standard Survey Form _____

7. Who provides Lab Standard training for your Faculty?
   _____
   _____

8. Who provides Lab Standard training for your lab employees?
   _____
   _____

9. Number of lab related injuries or illnesses in 2002?
   Sum of # 8 Faculty and Principal Investigator Lab Standard Survey Form _____

10. Number of lost workdays due to lab related injuries or illnesses in 2002?
    Sum of # 9 Faculty and Principal Investigator Lab Standard Survey Form _____

OEHS, 1314 Kinnear Road Rm 210, CAMPUS

Complete and return copies to Vice President Research, Provost, and OEHS by April 25, 2003

College Summary Form Date:_____
Lab Standard Survey

College Name: _____

College Dean: _____

College Chemical Hygiene Officer or
Chemical Hygiene Committee Chair: _____

1. Number of affected Departments:_____
2. Number of affected Labs:
   Sum of # 3 Department Summary Form Lab Standard Survey _____
3. Number of affected Faculty:
   Sum of # 1 Department Summary Form Lab Standard Survey _____
4. Number of affected Faculty who have received Lab Standard Training;
   Sum of # 2 Department Summary Form Lab Standard Survey _____
5. Number of affected lab employees:
   Sum of # 5 Department Summary Form Lab Standard Survey _____
6. Number of affected lab employees who have received Lab Standard Training:
   Sum of # 6 Department Summary Form Lab Standard Survey _____
7. Number of Faculty research groups that have completed Chemical Hygiene Plans:
   Sum of # 4 Department Summary Form Lab Standard Survey _____
8. Number of lab related injuries or illnesses in 2002?
   Sum of # 9 Department Summary Form Lab Standard Survey _____
9. Number of lost workdays due to lab related injuries or illnesses in 2002?
   Sum of # 10 Department Summary Form Lab Standard Survey _____

OEHS, 1314 Kinnear Road Rm 210, CAMPUS

March 19, 2003

«FirstName» «LastName»
College of «Company»
«Address1»
«Address2»
Campus Mail

RE: 2003 Lab Standard Implementation Survey

Dear Dean «LastName»:

On September 12, 2002, Executive Vice President and Provost Edward Ray and Vice President for Research C. Bradley Moore challenged the deans of colleges affected by OSHA's Lab Standard to complete implementation of the standard by April 2003. Successful implementation consists of completed Chemical Hygiene Plans and completed training for both faculty and staff for 90% of all affected departments and personnel. To assess the success of University wide implementation efforts, the attached survey forms, are to be distributed to department chairs and faculty. The Faculty or Principal Investigator Lab Standard Survey Forms are to be completed by each affected Faculty member and returned to Department Chairs by April 4, 2003. Each affected department should gather these forms and complete a Department Summary Form (DSF) for each department and forward the DSF to the dean of the college by April 18. The College Summary Form (CSF) will summarize the information on the DSF's. The CSF is to be forwarded to the Provost, the Vice President for Research and the Institutional Chemical Hygiene Officer by April 25. Thank you for your cooperation and implementation efforts.

As always, I can provide assistance in this regard upon request.

Respectfully yours,

Tim Govenor
Institutional Chemical Hygiene Officer

Cc: Edward Ray, C. Bradley Moore and Cecil Smith

Enclosed forms: Faculty and Principal Investigator Lab Standard Survey
Department Summary Form
College Summary Form

April 4, 2002

Edward J. Ray
Executive Vice President and Provost
203 Bricker Hall
190 North Oval Mall
Campus

C. Bradley Moore
Vice President, Research
208 Bricker Hall
190 North Oval Mall
Campus

Dear Provost Ray and Vice President Moore:

One year ago, we reported the university's progress on implementing OSHA's Lab Standard. This report will provide progress made by colleges in the past year. As was done last year, surveys were distributed through the Deans, to Department Chairs and Faculty in January and a response was requested by the end of February. The following information reflects responses from colleges received through March 27, 2002.

First it should be noted that the 2001 report has significantly changed due to the late receipt of information from the College of Engineering and the College of Food, Agriculture and Environmental Sciences. These colleges have a large number of labs, affected faculty and employees. Thus, the chart illustrating percentages of these populations that had completed training has been changed and now better reflects the total university progress in 2001. The updated 2001 chart is attached (2001 University Lab Standard Implementation Status Report by College). Previously, university compliance in 2001 was estimated at 50%. With the more complete data, that estimate is revised to 30%.

The second chart (2002 University Lab Standard Implementation Status Report by College) is compiled from data received to date from this round of information. Colleges with an asterisk have not submitted college summaries or have submitted incomplete reports, as not all departments in these colleges have submitted the required information. Based on what has been reported to date overall university implementation is an estimated 60%

The charts illustrate the percentages of affected faculty who have received required training, the percentages of lab employees who have received required training and

percentages of affected faculty with completed hygiene plans for their labs. Data for the charts are also included.

Three additional charts have been included with this report to indicate the percentage of affected faculty who have completed training, the percent of affected employees who have completed training and the percentage of affected faculty research groups that have completed chemical hygiene plans in 2001 vs. 2002. The Colleges of Nursing, Education, Human Ecology, and Pharmacy have completed their implementation efforts and have only to continue training new faculty and staff. It is also evident that FAES, COMPH, Veterinary Medicine and Dentistry all made significant progress in faculty and employee training in the past year. Biological Sciences, MAPS and Engineering have made the least progress since 2001.

In 2000, fifty-five (55) accident reports were received from laboratories compared to forty-seven (47) in 2001. The most frequent causes of injury were handling glass/sharps followed by contact with chemicals. Hands and eye/face were most frequently injured body parts in both years. In 2000, there were 36 hand injuries and 6 eye/face injuries. In 2001, there were 22 hand injuries and 7 eye/face injuries.

Your interest and support for the surveys were very instrumental toward obtaining cooperation from the colleges. However, as can be seen, more work needs to be done in several colleges. A few words of congratulations, for this level of achievement, and encouragement, to complete implementation by year's end, will help colleges and deans remain focused on completing Lab Standard implementation. Sharing these results with affected deans is recommended. It is our belief that the university can be in substantial compliance (>90%) by January 2003. At that time we will repeat the surveys.

We would be glad to provide any additional information regarding this report or gather other information that would be of interest to you regarding laboratory safety management issues.

Sincerely,

Tim Govenor
Institutional Chemical Hygiene Officer

Cecil Smith
Assistant Vice President

Attachments: 2001 University Lab Standard Implementation Status Report by College
2002 University Lab Standard Implementation Status Report by College
Percent of Faculty Trained by College
Percent of Employees Trained by College
Percent of Faculty with Chemical Hygiene Plans

Cc: James Stevens
William Shkurti

Laboratory Safety Program

Chemical Fume Hood Safety

Power Point Presentation

a. Objective: Learn about the proper operation of a chemical fume hood and the safe work practices associated with its operation.
b. Outline
    1. Federal Laboratory Safety Standard
    2. Safe and Unsafe Work Practices (Examples)
    3. Hood Performance and Testing
    4. Flow Indicators
    5. Maintenance and Care
c. Supplemental Information
    a. A Survival Guide to Chemical Fume Hoods

Web Information

American National Standards Institute (ANSI): www.ansi.org
American Industrial Hygiene Association (AIHA): www.aiha.org
American Society of Heating, Refrigerating, and Air Conditioning Engineers, Inc (ASHRAE): www.ashrae.org
OSU Environmental Health and Safety: www.ehs.ohio-state.edu

Recommended Reading

OSU, A Survival Guide to Chemical Fume Hoods
Prudent Practices in the Laboratory: Handling and Disposal of Chemicals, NAS
Safety in Academic Chemistry Laboratories, ACS
Industrial Ventilation Manual, ACGIH
ANSI/AIHA Standard Z9.5, Laboratory Ventilation
ASHRAE Standard 110-1995 Method of Testing Performance of Laboratory Fume Hoods

Laboratory Safety-Fume Hoods

29 CFR 1910.1450 Laboratory Safety Standard

Laboratory Safety-Fume Hoods

Chemical Hoods

- Conventional
- Bypass
- Auxiliary Air Bypass
- Re-circulating/Ductless

Non-Chemical Hoods

- BioSafety Cabinets
- Laminar Flow Hoods

Laboratory Safety-Fume Hoods

Chemical Hood Types

Horizontal Sash	Vertical Sash
Combinations	Canopy
California	Slotted
Walk-in	Etc.

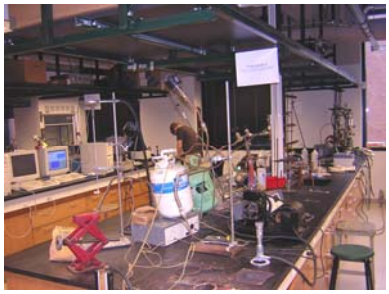
Laboratory Safety-Fume Hoods

Unstable Set- Up

Flammable and Toxic Atmospheres

Laboratory Safety-Fume Hoods

Unsafe Experiment



Laboratory Safety-Fume Hoods

Chemical Contamination

Laboratory Safety-Fume Hoods

Proper Set Up:

Brightly Illuminated

Clean

Apparatus 6" Inside

Slots Unobstructed

Laboratory Safety-Fume Hoods

Unsafe

Lab

Practice

Laboratory Safety-Fume Hoods

Unsafe

Lab

Practice

Laboratory Safety-Fume Hoods

Safe

Lab

Practice

Laboratory Safety-Fume Hoods

Improper Chemical Storage

Restricted Airflow

Chemical Escape

Incompatible Chemicals

Chemical Contamination

Laboratory Safety-Fume Hoods

Proper Chemical Storage

Hazard Class

Secured

Labeled

Dry

Laboratory Safety-Fume Hoods

Proper Material Storage

Side or Rear

6" Beyond Sash

Maximum 25% Slot Blockage

Laboratory Safety-Fume Hoods

Improper Equipment Storage

Sash Restricted

Slot Opening Blocked

Airflow Restricted

Limited Protection

Laboratory Safety-Fume Hoods

Proper Equipment Storage

Elevate Apparatus

Promote Airflow

Contain Contaminants

Laboratory Safety-Fume Hoods

Improper Waste Disposal

Unsafe

Illegal

Laboratory Safety-Fume Hoods

Closed Sash Position

One-Third Opening

Chemical Exposure

Explosion Protection

Fire Containment

Laboratory Safety-Fume Hoods

Open Sash Position

Set Up

Tear Down

Hazard Absent

Laboratory Safety-Fume Hoods

Damaged Sash

Limited Protection

Report Damage

Repair Before Using

Laboratory Safety-Fume Hoods

Raised Sash (Unattended)

Reduced Air Velocity

Fire/Explosion

Chemical Exposure

Laboratory Safety-Fume Hoods

Lowered Sash (Unattended)

Increased Air Velocity

Contain Fire/Explosion

Limit Exposure

Laboratory Safety-Fume Hoods

Open Lab Door

Unrestricted Traffic

Air Turbulence

Room Depressurized

Chemical Exposure

Fire and Explosion

Laboratory Safety-Fume Hoods

Closed Lab Door

Control Foot Traffic

Limit Turbulence

Room Pressurized

Limit Chemical Exposure

Contain Fire and Explosion

Provide Security

Laboratory Safety-Fume Hoods

Hood Performance

Ventilation Measurements

Various Test Methods

Face Velocity Measurements

Sash Height

Hood Contents

Laboratory Safety-Fume Hoods

Hood Performance

Ventilation Smoke

Flow Patterns

Laminar Flow

Turbulence

Eddy Currents

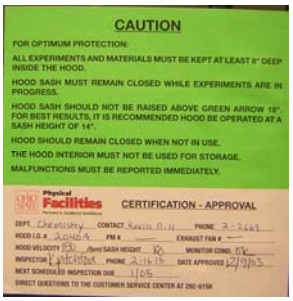
Back Drafts

Laboratory Safety-Fume Hoods

Hood Performance

Certification Approval

Caution Information



Laboratory Safety-Fume Hoods

Hood Performance

Danger Notice

Do Not Use

Laboratory Safety-Fume Hoods

Hood Performance

Tissue Paper

Ribbon

Laboratory Safety-Fume Hoods

Hood Performance

Flow Indicator

Static Pressure

Acceptable Range

Alarm Mechanism

Test Alarms

Laboratory Safety-Fume Hoods

Hood Performance

Flow Indicator

Air Velocity

Acceptable Range

Alarm Mechanism

Test Alarms

Laboratory Safety-Fume Hoods

Ventilation System

Duct Work

Fan

Exhaust Stack

A Survival Guide to Chemical Fume Hoods

Published By: The Division of Environmental Health and Safety

INTRODUCTION

Laboratory hood safety may not be an important issue for everyone. However, for people who work in laboratories it is especially critical. Why? Because for worker protection, the laboratory fume hood is the most useful piece of safety equipment found in the lab. When used appropriately, fume hoods not only provide protection from toxic gases and vapors but also provide protection from unanticipated fires and explosions. In short it could save you from serious injury or death.

As with any type of equipment you use, you should become familiar with how the hood works and its limitations. The following listing will help you to recognize the specific types of hoods commonly found at O.S.U.

TYPES OF FUME HOODS

Conventional: All air enters through the hood opening as defined by the bottom of the sash, the sides of the hood and the work surface.

Conventional Bypass: As the sash is closed, some of the air enters through a bypass grille instead of through the sash opening to help maintain a constant velocity. The bypass is usually located directly above the sash.

Auxiliary Air: In this type of hood some of the air being drawn into the opening is supplied directly at the hood. The delivery duct for this air is usually located just above the bypass grille and extends out 1-2 feet.

Radioactive: Any of the above hoods can be used for radioactive materials provided the interior work surfaces are impervious (usually stainless steel). Some types of radioactive material also require a filter at the hood outlet and surveillance by the Office of Radiation Safety.

Perchloric Acid: Any of the above hoods can also be used for perchloric acid provided the hood has a water wash-down system. Use of small quantities (ml) of perchloric acid at room temperature (no heating) does not require a wash-down facility.

Glove Box: This is a complete enclosure whose only access is through a side pass-through chamber or the gloves in front. It is usually kept under a negative pressure of approximately 0.5 inches of water.

Bio Safety Cabinet: This is not a chemical fume hood. It is used for biological materials. Only small amounts of non-volatile chemicals can be used in these cabinets.

Horizontal vs. Vertical Sliding Sash: The majority of hoods have one or two vertical sliding sashes, i.e., they move up and down. Some hoods have three or more horizontal sliding sashes, i.e., they move left to right.

1. Walk-in Hoods
2. Canopy Hoods (like kitchen stove hoods)
3. Slot Hoods (usually several feet in length with a slot of several inches)
4. Atomic Absorption Spectrophotometer Exhausts.

HOOD MAINTENANCE AND USE

The University evaluates chemical fume hoods periodically to ensure that they are functioning appropriately. Physical Facilities and Facilities Maintenance (University Hospitals) perform preventive maintenance on the fume hood motors and exhaust fans. They also repair or replace faulty utilities, sashes and safety glass. The Division of Environmental and Occupational Health and Safety evaluates hood capture velocity and provides training to interested laboratory personnel regarding hood safety.

However, if improperly used, even the best hood can be compromised beyond its capabilities. When improperly used, toxic chemical vapors and gases can escape into the laboratory and jeopardize the health of laboratory workers.

The following page contains safe work practices for using laboratory fume hoods. When followed, these practices will limit the risk of exposures to toxic chemicals used in the hood.

WORK PRACTICES FOR LABORATORY FUME HOODS

1. Know the physical, chemical, and toxicological properties of all chemicals you use.
2. Conduct all operations which may generate air contaminants at or above the appropriate Threshold Limit Value~ inside a hood (50 ppm or less).
3. Keep all apparatus at least 6 inches back from the face of the hood. A stripe on the bench surface is a good reminder.
4. Elevate large equipment 1 to 2 inches above the working surface of the hood.
5. Do not place your head inside the hood when contaminants are being generated.
6. Do not use the hood as a chemical waste disposal mechanism.
7. Do not store chemicals or apparatus in the hood.
8. Keep the hood sash at the lowest possible position and use the sash as a shield.
9. Keep the slots in the hood baffle free from obstruction.
10. Keep laboratory doors closed (exception is when lab design requires the doors be open).
11. Minimize foot traffic and rapid movement past the face of the hood.
12. Do not remove hood sash or panels except when necessary for apparatus setup; replace sash or panels before operating.
13. Do not place electrical receptacles or other spark sources inside the hood when flammable liquids or gases are present. Permanent electrical receptacles are best located outside of the hood.
14. Use an appropriate barricade or shield if there is a chance of explosion or eruption (i.e., unstable reaction intermediates, strong oxidizers, exothermic reactions).
15. If hood sash is supposed to be partially closed for operation, the hood should be so labeled and the appropriate closure point clearly indicated.
16. Provide adequate maintenance for the hood exhaust system and the building supply system. Use static pressure gauges or other appropriate indicators to insure proper exhaust flow.

Laboratory Safety Program

Personal Protective Equipment (PPE)

Power Point Presentation

a. Objective: Learn about the different types of personal protective equipment available for protection from various chemical, physical, and biological agents and how to properly select, use, and maintain this safety gear.
b. Outline
    1. Federal Personal Protective Equipment Standard
    2. Requirements of the standard
    3. Workplace hazards
    4. Injury examples
    5. PPE examples
    6. Industry/Government Certification
    7. Chemical Resistance Factors
c. Disposable Glove Demonstration
d. Supplemental Information
    1. Chemical Protective Clothing Selection
    2. Proper Glove Removal

Web Information

OSU Environmental Health and Safety, www.ehs.ohio-state.edu
OSU Department of Chemistry, www.chemistry.ohio-state.edu
BWC Division of Safety and Hygiene Training Center, www.bwc.state.oh.us/employer
Occupational Safety and Health Administration (OSHA), www.osha.gov

Recommended Reading

Chemical Protective Clothing Selection, Applied Industrial Hygiene Journal
NIOSH Pocket Guide to Chemical Hazards
Chemical Protective Clothing, Forsberg and Mansdorf

Personal Protective Equipment

David E. Kos

Federal Regulations

- 1910.132 General Requirements
- 1910.133 Eye and Face Protection
- 1910.134 Respiratory Protection
- 1910.135 Head Protection
- 1910.136 Foot Protection
- 1910.137 Electrical Protection
- 1910.138 Hand Protection
- 1910.156 Body Protection
- 1910.95 Hearing Protection

Hazards

- Chemical
- Physical
- Biological
- Radiological
- Ergonomic

Some of the following pictures show graphic injuries

Laboratory Safety-PPE

Health Hazard

- Arms
- Hands

Laboratory Safety-PPE

Health Hazard

- Hands

Laboratory Safety-PPE

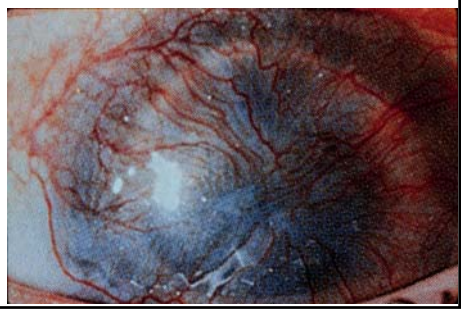
Health Hazard

- Eyes
- Face

Laboratory Safety-PPE

Health Hazard

- Eyes



Laboratory Safety-PPE

Equipment Types

Whole Body	Hand
Eye	Face
Ear	Respiratory
Foot	Head

Laboratory Safety-PPE

Torso Protection

Laboratory Safety-PPE

Hand Protection

Laboratory Safety-PPE

Eye Protection

- **Safety Glasses**
- **Goggles**
- **Face Shields**

Laboratory Safety-PPE

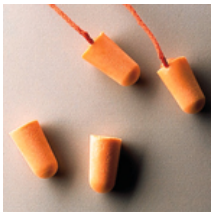
Foot Protection

- **Safety Shoes**
- **Safety Boots**

Laboratory Safety-PPE

Ear Protection

- **Ear Plugs**
- **Ear Muffs**



Laboratory Safety-PPE

Respirators

- **Working with OSHA Carcinogens, etc.**
- **Medical Certification**
- **Fit Testing**

Laboratory Safety-PPE

American National Standards Institute (ANSI)

- **Z87 on Frames**
- **Etching On Lenses**

Other Standards Agencies

- **NIOSH, UL, MSA, NFPA, etc.**

Laboratory Safety-PPE

Selection Criteria

- **Reasonably Comfortable**
- **Snug Fitting**
- **Durable**
- **Cleanable**
- **Serviceable**

Laboratory Safety-PPE

Equipment Inspection

- **Cracked**
- **Distorted**
- **Damaged**
- **Deteriorated**
- **Dirty**
- **Discolored**

Laboratory Safety-PPE

Equipment Usage

- **Inspect**
- **Donn**
- **Adjust**
- **Wear**
- **Doff**
- **Clean**
- **Store**

Laboratory Safety-PPE

Equipment Care

- **Inspect**
- **Discard**
- **Repair**
- **Clean**
- **Sanitize**
- **Store**

Laboratory Safety-PPE

Skin and Chemical Reaction

- **Barrier**
- **Irritation**
- **Burn**
- **Penetration**
- **Sensitization**

Laboratory Safety-PPE

Chemical Resistance

- **ALL MATERIALS ARE PERMEABLE**
- **NO UNIVERSAL BARRIERS**
- **Chemical Resistance Varies**

Laboratory Safety-PPE

Permeation Factors

- **Concentration**
- **Multiple Components**
- **Thickness**
- **Temperature**

Laboratory Safety-PPE

Chemical Resistant Materials

- **Natural Rubber (Latex)***
- **Butyl Rubber***
- **Chloroprene (Neoprene Rubber)***
- **Styrene Butadiene Rubber (SBR)**
- **Polyvinyl Chloride (PVC)***
- **Polyethylene (PE)***
- **Polypropylene (PPE)**
- **Polyvinyl Alcohol (PVA)***
- **Nitrile***
- **Fluorocarbon Rubber (Viton)**
- **Ethylene Vinyl Alcohol (EVAL)**
- **Polytetrafluoroethylene (Teflon)**

*Commonly Available and Relatively Inexpensive

Laboratory Safety-PPE

Chemical Resistance Guide

- **Degradation**
- **Permeation**

Laboratory Safety-PPE

General Glove Tips

- **Replace When Contaminated (disposable)**
- **Do Not Wear Them Outside of the Lab**
- **Practice Good Chemical Hygiene**

Laboratory Safety-PPE

Donning and Doffing Gloves

Chemical Protective Clothing Selection

Introduction

Skin is an organ of the human body and has a surface area of about 1.8 m^2. A principal function of skin is to protect our internal organs from exposure to potentially harmful components of the external environment. Direct contact with chemicals can pose a significant challenge to the skin; possible reactions are:

- The skin will act as an effective barrier, and there will be no detrimental effect due to the contact.
- The skin will suffer a primary irritation such as a burn (corrosion), chafing due to extraction of essential oils, or dermatitis.
- The skin will become sensitized to the chemical. Once sensitized, the skin will react to quantities of chemicals much smaller than otherwise would have any effect. Some chemicals are both primary irritants and sensitizers.
- The skin will be penetrated by the chemical, and the chemical and/or its metabolites will enter the blood stream. This may or may not have a health effect, depending on the chemical and the amount of exposure.

The latter type of reaction, which would include, for example, irreparable liver damage and cancer, receives a high level of attention from both the lay and the technical communities. And, of course, such debilities warrant serious consideration. However, it is also important to recognize that primary skin irritations and sensitizations account for significantly greater numbers of lost time incidents. It is estimated that skin diseases account for two-thirds of all identified job-related diseases. Furthermore, seven out of ten industrial claims paid by insurance companies are for temporary disability resulting from dermatitis.

Along with engineering controls and carefully planned work procedures, chemical protective clothing (CPC) is a key element in minimizing the potential for worker exposure to chemicals. CPC includes all items of clothing primarily intended to prevent chemical contact with the skin. These include gloves, coveralls, pants, jackets, and boots. Respirators are not included in this classification.

CPC Limitations

The use of chemical protective clothing is but one component of the overall program for maintaining the health and safety of workers. It complements (and is not a substitute for) good planning, work practices, engineering and administrative controls, or personal hygiene. Several factors which should be considered in the specification and selection of CPC are discussed in the following paragraphs.

Chemical Resistance

The performance of CPC as a barrier to chemicals is determined by the materials and quality of its construction. Chemical protective clothing is based on plastic and elastomeric materials. Typically, each chemical interacts with a given plastic or elastomer in a relatively unique manner. That is, each chemical/material pair has peculiar interactions. The situation becomes even more complex when multi-component solutions are involved. Four important factors to bear in mind when considering CPC are:

- In general, there is no such thing as "impermeable" plastic or rubber clothing.
- No one clothing material will be a barrier to all chemicals.
- For a given clothing material type, chemical resistance can vary significantly from product to product. For example, not all brands of nitrile gloves provide equivalent protection.
- For certain chemicals or combinations of chemicals, there is no commercially available glove or clothing that will provide more than an hour's protection following contact. In these cases, it is recommended that clothing be changed as soon as it is safely possible after any contact with the chemical or chemical mixture.

Design and Construction

Design and construction factors that can influence performance are as follows:

- Stitched seams of clothing may be highly penetrable by chemicals if not overlayed with tape or sealed with a coating.
- Lot-to-lot variations do occur and may have a significant effect on the barrier effectiveness of the CPC. They may go undetected due to quality control procedures insensitive to chemical resistance issues.
- Pinholes may exist in elastomeric or plastic products due to deficiencies or poor quality control in the formulation or in the manufacturing processes.
- Thickness may vary from point to point on the clothing item. Depending on the manufacturing process, the finger crotch area of the glove is particularly susceptible to thin coverage.
- Garment closures differ significantly from manufacturer to manufacturer and within one manufacturer's product line. Attention should be paid to button and zipper areas and the number of fabric overlaps in these areas.

Gloves are typically produced by one of two principal processes—latex-dipping and solvent (cement) dipping. Latex gloves predominate the market. Researchers have speculated, however, that the chemical resistance of a solvent-dipped glove may be greater than that of a latex-dipped glove of the same generic material. The principal reason for this is that the solvent-dipped glove is produced by a multiple-dip process while the latex process is a single-dip operation. In a multiple-dip process, imperfections in any one layer are covered by subsequent layers. Since the solvent-dip process is more involved, these products are generally more expensive. Consequently, the manufacturers of such gloves typically highlight the fact the gloves are solvent-dipped in justifying the cost.

Application

The degree of protection provided by an item of clothing is also a function of the application. For example, a less durable piece of clothing may be more than adequate for a moderate duration, mild activity (e.g., sampling) whereas it would not endure more than 5 minutes of a vigorous, emergency response activity. Factors such as abrasion, puncture and tear resistance, and reaction to perspiration and crumpling should be considered. Temperature and,

to some extent, humidity have significant influences on the performance of elastomeric and plastic CPC. Also with regard to application, it is important to recognize that protective clothing can be cumbersome and restrictive and thereby hasten the onset of worker fatigue. A result is that the period of safe and effective worker activity may be reduced.

Reuse

Protective clothing decontamination and reuse are controversial and unresolved issues at this time. Often, surface contamination can be removed by scrubbing with soap and water. In other cases, especially with highly viscous liquids, surface decontamination may be practically impossible, and the CPC should be discarded. A more subtle problem arises with regard to the detection and removal of a chemical that has been absorbed into the elastomer or plastic. Once absorbed, some of this chemical will continue to diffuse through the material towards the inside surface even after the surface has been decontaminated.

For highly resistant clothing, the amount of chemical reaching the inside may be insignificant. However, for moderately performing materials, significant amounts of chemical may reach the inside. This may not occur during the work shift but can take place while, for example, a glove is stored overnight. The next morning when the worker dons the glove, the skin may be placed in direct contact with a hazardous chemical. In addition to chemical resistance, which is a function of temperature, both duration and the surface area exposed affect the amount of chemical that may reach the inside surface.

Reuse decisions must consider these factors as well as the toxicity of the involved chemical(s). In fact, unless extreme care is taken to ensure decontamination, the reuse of CPC which has been contacted with highly toxic chemicals is not advisable. In summary, the decision to reuse CPC must take into account previous uses; unfortunately, there is little or no documented experience for guidance in this task.

Substitution of CPC

Particular caution is required when substituting clothing from one manufacturer for that of another manufacturer. Clothing performance is determined by the type of plastic or elastomer, the specific formulation of that plastic or elastomer, and the clothing manufacturing process. For example, materials classified generically as nitrile rubber can differ significantly in composition and, therefore, chemical resistance. Testing is the only means for identifying the superior products for a particular application.

Cost

Cost is an important consideration in the selection and utilization of clothing, especially where clothing is likely to be damaged (e.g., tear, puncture, etc.). In some cases, it may be more cost-effective to adopt the practice of using multiple changes of less expensive but relatively poorer performing clothing than to attempt to extend the use of better performing but more expensive clothing.

Permeation Theory

An important aspect of the problem of selecting the most appropriate CPC for situations where human exposure to potentially hazardous chemicals is possible is the effectiveness of the CPC as a barrier to the chemicals. Barrier properties may be estimated by simple immersion tests wherein the CPC or a portion thereof is exposed to the chemical(s) of concern, and the material is then examined for obvious signs of degradation, swelling, or weight changes. This has been the traditional method for generating the chemical resistance tables which are included in many CPC brochures. It is important to note, however, that permeation may occur with little or no visible or physical effect on clothing materials.

The barrier effectiveness of CPC can be measured by permeation testing. The standard procedure for performing permeation tests is the American Society for Testing and Materials (ASTM) Method F739-85 promulgated by ASTM Committee F-23. This same committee has developed a standard battery of chemicals for permeation testing in ASTM F1001-86. The 15 chemicals in the battery represent a wide range of chemicals (e.g., ketones, acids, bases, hydrocarbons, etc.). Permeation testing with these chemicals will facilitate the comparison of clothing materials.

Permeation Theory Concepts

Permeation of a liquid or vapor through a rubber or plastic material is a three-step process involving:

- Sorption of the chemical at the outside surface of the CPC.
- Diffusion of the chemical through the CPC material.
- Desorption of the chemical from the inside surface (i.e., towards the wearer) of the CPC.

Of principal importance in seleeting CPC for protection from chemicals is the rate at which chemicals permeate the clothing materials and the time elapsed between the contact with the chemical and the appearance of the chemical on the inside of the CPC (i.e., breakthrough time).

Permeation Rate

Classical permeation theory (Fick's Law) states that the chemical permeation rate through a material is a function of the:

- Diffusion coefficient of the permeating chemical in the material (this is a property of the chemical/material pair).
- Difference in chemical concentrations between the inside and outside surfaces of the material.
- Thickness of the material.

Permeation rate is often expressed in terms of the amount of a chemical which passes through a given area of clothing per unit time. (Common units are micrograms per square centimeter per minute.) Thus, obviously, the total amount of chemical permeating an article of clothing increases as the area exposed to the chemical is increased and also as the duration of exposure is lengthened. For a given chemical/material pair, the permeation rate decreases as the material thickness is increased. The concentration gradient mentioned above pertains to concentrations in the clothing material itself. Thus, there is generally a decrease in permeation rate as the amount of chemical absorbed by the material decreases.

Breakthrough Time

Breakthrough time is defined as the elapsed time from initial contact of the outside surface of the CPC with chemical to the first detection of chemical on the inside surface. In some cases (e.g., when handling suspect carcinogens), breakthrough time may be the single most important criterion for CPC selection. Measured breakthrough times are readily determined by permeation testing and are dependent on the sensitivity of the analytical method used in the test and the test procedure. These factors should be considered when comparing breakthrough time data.

Influencing Factors

Temperature

Most CPC permeation data and other chemical resistance information are generated

at 20°–25°C. Permeation rates increase and breakthrough times decrease with increasing temperatures. The extent of the reduction in barrier performance with increasing temperature is dependent on the chemical/material pair.

CPC Thickness

For a given chemical/clothing material pair:

- Permeation is inversely proportional of thickness. Thus, doubling the thickness will theoretically halve the permeation rate.
- Breakthrough time increases with thickness. However, there is no simple mathematical relationship for calculating the breakthrough time at one thickness from that at another thickness.

Solubility Effect

Permeation rate is a direct function of the solubility of the chemical in the CPC material. Solubility is the amount of chemical that can be absorbed by a given amount of CPC material (i.e., grams liquid per gram material); absorption may be accompanied by swelling. In general, chemicals having high solubilities will rapidly permeate the CPC material in question. Thus, simple immersion testing to determine solubility is an expedient means for preliminary evaluation of candidate CPC items.

Caution in interpreting solubility data is required, however, since low solubilities do not necessarily correspond to low permeation rates. It is important to remember that permeation rate is a function of both solubility and diffusion coefficient. Gases, for example, have low solubilities but high diffusion coefficients and may permeate CPC materials at rates several times greater than a liquid with moderate to high solubility in the material.

Multicomponent Liquids

Multi-component liquids represent a difficult problem relative to the selection of the most appropriate CPC. Rarely is there any prior CPC experience with the particular solution of concern, and often the components of the solution are not known. Furthermore, mixtures of chemicals can be significantly more aggressive towards plastics and rubbers than any one of the components alone. Finally, the presence of a small fraction of a rapidly permeating component may carry a chemical that would permeate at a slower rate if in pure form.

At the present time, researchers are attempting to develop correlations for the prediction of multi-component permeation. However, this work is in its early stages. In the meantime, immersion and permeation testing are recommended as the best means of selecting CPC for multi-component solutions.

Persistent Permeation

Once a chemical has begun to diffuse into a plastic/rubber material, it will continue to diffuse even after the chemical on the outside surface is removed. This is because a concentration gradient has been established with the material, and there is a natural tendency for the chemical to move towards areas of lower concentration. This phenomenon has significant implications relative to the reuse of CPC. For example, a possible field scenario is:

- Chemical contacts and absorbs into a glove.
- Breakthrough does not occur during the workday since the glove has low permeability to the chemical.
- Prior to removal, the glove is washed to remove surface chemical, but
- The next morning some fraction of the absorbed chemical has reached the inside surface of the glove due to continued diffusion.

Of course, similar scenarios could occur over both shorter and longer time frames, for example, morning to afternoon or over a weekend. The user must take this possibility into account when reuse is considered.

CPC Use Procedures

Purchase

Protective clothing is purchased either directly from the manufacturer or through a CPC distributor. The larger distributors carry several manufacturers' products and a wide variety of products. Virtually every manufacturer has a catalogue of its products which describes each product as to the sizes available, thickness of the rubber or plastic barrier, and the materials of construction.

Many of the catalogues also contain chemical resistance ratings charts for the products. The reliability of the ratings varies from vendor to vendor. Some ratings are based on extensive testing, while others would appear to have minimal supporting evidence.

Pre-use Inspection

Each item of clothing should be inspected immediately upon removing it from the package. First determine that the material of construction is that which was ordered or specified for the task at hand. This will involve comparing the item number with the catalogue number. Items of different materials should be kept separated. (See Storage below.)

Visually inspect the items for defects such as imperfect seams, non-uniform coatings, pinholes, malfunctioning closures, and tears. Some flexible materials may stiffen during extended storage periods; flex the product and observe for surface cracks or other signs of shelf-life deterioration. Pinholes may be detectable by holding the garment up to a light in a dark room. Gloves with holes can be identified by pressurizing the glove. This can be accomplished by blowing into the glove and then tightly rolling the gauntlet towards the fingers (thereby reducing volume and increasing pressure) while observing that the glove holds pressure. Alternatively, the glove could be inflated and then held under water and examined for the presence of air bubbles. Full-body encapsulating ensembles should be checked for the operation of pressure relief valves and the fittings at the wrists, ankles, and neck.

Donning

Each worker should thoroughly inspect the clothing to be worn immediately before donning. Of principal concern are cuts, tears, punctures, and discoloration or stiffness which may be indicative of chemical attack resultant from previous use or non-uniformities in the rubber or plastic. The wearer should understand all aspects of the clothing operation and its limitations; this is especially important for full-body encapsulating ensembles where misuse could potentially result in suffocation. Note some materials may have temperature limitations; for example, some CPC become stiff and may be unusable at low temperatures.

Once the clothing is on, all closures should be secured and checked. Use the "buddy system." Finally, the fit of the clothing should be evaluated. Improperly fitting protective clothing represents a severe potential hazard. Where clothing is too small, worker movement is restricted, likelihood for tear is increased, and the potential for accelerated worker fatigue is increased. Where the clothing is too large, the possibility of snag is increased, and the dexterity and coordination of the worker may be compromised.

In-use

During the course of the work task, each

worker should periodically inspect the protective clothing. Of principal concern are tears, punctures, seam discontinuities, or closure failure that may have developed while working. Evidence of chemical attack such as discoloration, swelling, stiffening, or softening should also be noted. (Note: Permeation can occur without any visible effects on the clothing material.) Any item of clothing that has been physically damaged or chemically degraded should be doffed and replaced as soon as safely possible.

Doffing

A principal objective of the doffing process is to restrict the transfer of chemical from the work area. A second objective is to avoid contact of the person doffing the garment as well as others with chemical on the outside of the garment.

Detailed doffing procedures have been developed by the Environmental Protection Agency (EPA) and are contained in the *Interim Standard Operating Safety Procedures* of the Office of Emergency and Remedial Response, Hazardous Response Support Division. They address: doffing site location, decontamination, and disposal of contaminated garments.

Storage and Reuse

Several considerations relative to the storage and reuse of protective clothing primarily focus on hazards that could potentially develop upon the storage of contaminated clothing. Briefly, in cases where a chemical is absorbed by the clothing, the chemical begins to permeate into the clothing. Short duration washing of the clothing with soap and water removes surface contamination but not absorbed chemical. After surface decontamination, some of the absorbed chemical will continue to permeate the clothing material and may ultimately appear on the inside surface. This can happen during periods of overnight or weekend storage. Where such potential hazards may develop, clothing can be checked inside and out for discoloration or, if possible, by wipe testing for suspect chemicals prior to reuse. This is particularly important for full-body encapsulating ensembles which are generally subject to extensive reuse due to their cost. Note, however, that negative (i.e., no chemical found) test results do not necessarily preclude the possibility that some absorbed chemical will be released to the inside of the CPC during reuse.

It should be noted that, at the present time, there is very little documentation regarding clothing reuse. The use of disposable clothing, of course, obviates the problem. Where reusable CPC is required, however, the type of problem discussed above can best be minimized by selecting the most resistant clothing for the chemical at hand; such clothing will absorb little or no chemical. Furthermore, used clothing should be stored in well-ventilated areas. Ideally, there should be good air flow around each item of clothing.

Reuse of face shields and lenses is a particularly important issue. Good vision is required for both safety and efficiency on the work site. All such items should be inspected for crazing, cracks, and fogginess prior to use.

Finally, in storing protective clothing, different types of materials of clothing should not be mixed. For example, gloves which are black in color and virtually indistinguishable from one another may be made from nitrile, neoprene, Viton, polyvinyl chloride, butyl, etc., materials. Each material has unique chemical barrier properties. Mixing the gloves significantly increases the chance that a worker will be wearing the wrong clothing for the chemical of concern. It may be possible to separate mixed gloves by using the manufacturer's product number that is often found in the gauntlet area.

CPC Vendor's Literature

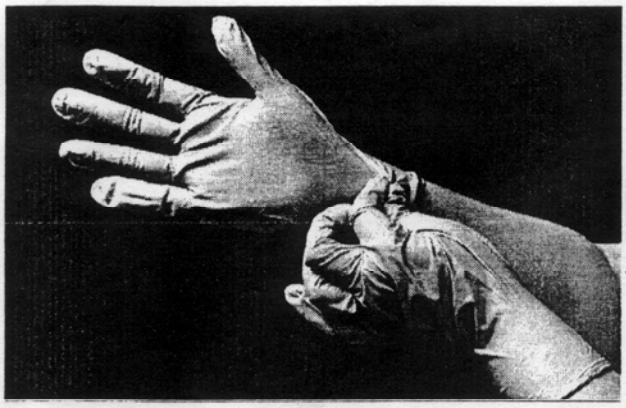
The most widely available sources of information on CPC are the product catalogues of the CPC manufacturers and vendors. These booklets contain descriptions of the types, sizes, and varieties of CPC produced by each manufacturer. In most cases, the basic materials of construction of the CPC are also included in the product descriptions. Many manufacturers also include information pertinent to the chemical resistance of their products or of the materials from which the products are fabricated. This information is often in the form of tables of qualitative chemical resistance ratings or use recommendations for the products/materials and particular chemicals. However, the leading manufacturers are increasingly providing information from permeation testing. A few vendors also provide information pertinent to abrasion, tear, etc., resistance but in general most catalogues do not address such application-related issues.

Information contained in typical CPC catalogues is both qualitative and quantitative. The qualitative ratings/recommendations are often on a four-grade scale of "excellent," "good," "fair," and either "poor" or "not recommended." In a small number of cases, five- or six-grade scales are used. With the exception of data based on permeation testing, the catalogues generally do not include information as to the basis for the recommendations. It would appear that, at present, most do not have (or at least are unwilling to share) performance specifications or quantitative test data for their products. The ratings/recommendations for a particular type of product (for example, nitrile gloves) for a particular chemical may vary from vendor to vendor. Both of these factors—little or no test data and inconsistencies among recommendation tables—make the selection, from qualitative information, of the best CPC for a given application a difficult and uncertain task.

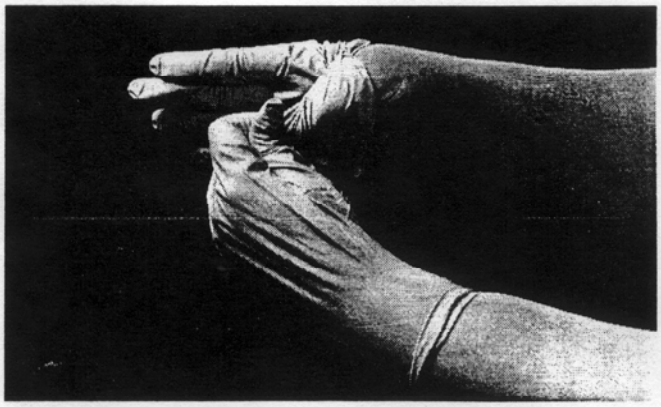
The most important consideration to keep in mind when using vendor recommendation tables, including those based on permeation tests, is that the tables are intended to provide guidance in the selection of CPC. That is, the tables are meant as a place to start the CPC selection process. The tables are meant for identifying candidate CPC for further evaluation and are particularly useful for identifying CPC from which poor performance would be expected and, therefore, which can be dropped from consideration. In no way do the recommendations address the wide variety of uses, challenges, and care to which the CPC may be subjected. Most vendors strongly emphasize this point in the descriptive text which accompanies the tables. In conclusion, the principal purpose of the catalogues is to provide information about products in terms of the sizes, styles, and materials of construction. The ratings charts should be used as a starting point for further evaluation if chemical resistance is an issue. ◊

PROPER GLOVE REMOVAL

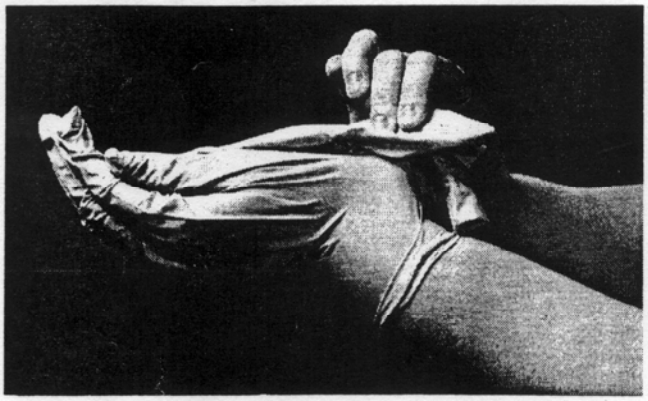
Following are the proper steps to safely remove a latex or nitrite glove. Following the proper procedure is vital to eliminate the possibility of getting harmful chemicals on your skin. It is recommended that you practice with a clean pair of gloves first.



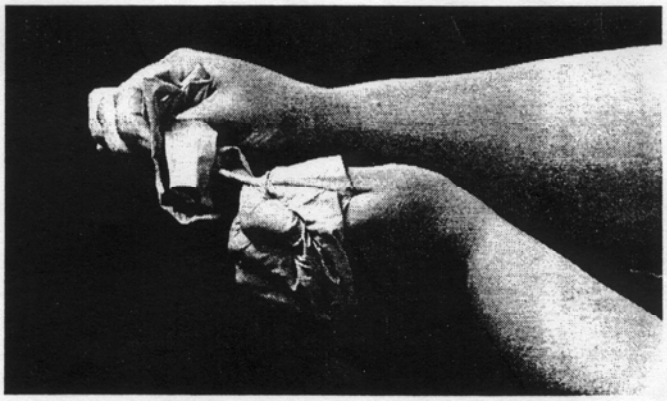
Step 1: Pinch the outside of the glove using the other gloved hand. By pinching slightly below the upper cuff you won't contaminate your skin.



Step 2: Pull the glove towards your fingertips. You will pull the glove wrong side out. All contaminants are trapped inside.



Step 3: Using the removed glove as a shield, place it over the wrist area of the remaining glove, pinch and pull the remaining glove towards the fingertips.



Step 4: Continue pulling towards the fingertips. This glove will also turn wrong side out.

Step 5: Complete the glove removal. Dispose of gloves in a proper manner. Wash hands to assure proper hygiene.

Laboratory Safety
Flammable Liquids and Fire Codes for Laboratories

1. Powerpoint Presentation
    a. Properties of Flammable Liquids
    b. The Phenomenon of Fire
    c. Fire Code
        i. Classification
        ii. Storage
    d. Charge Stratification
    e. Storage in Refrigerators
    f. Accidents
    g. Transport
2. Video on Fire Extinguishers
3. Supplemental Information
    a. Fire Extinguisher Guide
    b. Quick Reference Guide for Laboratory Fire Safety

Web Information

National Fire Protection Association (NFPA): http://www.nfpa.org
US Fire Administration: http://www.usfa.fema.gov/
State Fire Marshal: http://www.com.state.oh.us/ODOC/sfm/
Underwriters Laboratory: http://www.ul.com/
FireWise: http://www.firewise.org/ (with an excellent "links" page)

Recommended Reading

Fire Protection Handbook, NFPA
NFPA 30, 45, and 101

Flammable Liquids and Fire Codes for Laboratories

Properties of Flammable Liquids

Invisible Vapor is the Main Concern!

Properties of Flammable Liquids

Definitions: **FLASH POINT**

The temperature at which a liquid gives off sufficient vapors to form an ignitable mixture with air…near the surface of the liquid.

Laboratory Safety-Flammable Liquids

Properties of Flammable Liquids

Definitions: **Ignition Temperature**

The minimum temperature required to initiate or cause self-sustained combustion **without** ignition from an external source. Also called auto-ignition temp.

Laboratory Safety-Flammable Liquids

Properties of Flammable Liquids

Definitions: **Upper and Lower Explosive Limits**

The range of concentration of a flammable gas or vapor (% volume in air) in which a explosion can occur upon ignition in a confined area.

Laboratory Safety-Flammable Liquids

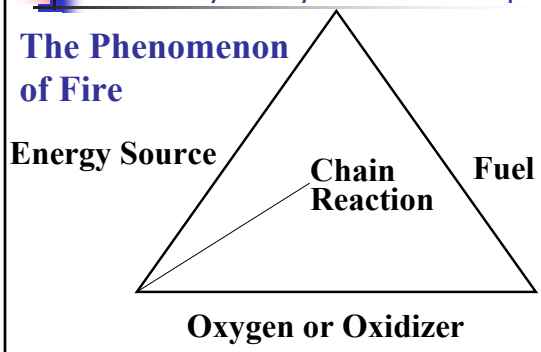
Compound	FP (°F)	LEL(%)	UEL
Acetone	0	2.6	13
Benzene	12	1.5	8
CS_2	-22	1	50
Ethanol	55	3	19
Et. Oxide	0	3.6	100
Ether	-49	2	36
Octane	60	0.5	3
Hydrogen		4	75

Laboratory Safety-Flammable Liquids

Compound	Ignition Temp	Vapor Density	Vapor Pressure
Acetone	1000°F	2	240 mm
Benzene	1044	2.77	100
CS_2	212	2.64	400
Ethanol	793	1.59	40
Ether	356	2.56	442
Octane	428	3.86	10
Hydrogen	1075	0.0069	

Laboratory Safety-Flammable Liquids

The Phenomenon of Fire



Laboratory Safety-Flammable Liquids

Fire Codes
Who Regulates Flammables?

- State Fire Marshal (NFPA, OBBC, and Ohio Fire Code)
- OSHA (Occupational Safety)
- DOT (Transportation)
- EPA (Flammable Waste)

Laboratory Safety-Flammable Liquids

Fire Codes-NFPA

- **Flammable liquids have a flash-point of less than 100°F**
- **Combustible liquids have a flash-point of 100°F or greater**

Laboratory Safety-Flammable Liquids

Fire Codes-NFPA
Flammable Liquid Classification

Class IA- FP<73°F, BP<100°F
Class IB- FP<73°F, BP>100°F
Class IC- 73°F ≥FP<100°F

Class II- 100°F ≥FP<140°F
Class IIIA- 140°F ≥FP<200°F
Class IIIB- FP ≥ 200°F

Laboratory Safety-Flammable Liquids

Fire Codes-NFPA
Flammable Liquid Classification
Common Class IA Solvents

- **Acetaldehyde**
- **Ethyl Ether**
- **Ethylene Oxide**
- **Pentane**

Laboratory Safety-Flammable Liquids

Fire Codes-NFPA
Flammable Liquid Classification
Common Class IB Solvents

Acetone	Benzene	Acetonitrile
Ethanol	THF	Ethyl Acetate
Hexane	Gasoline	Carbon Disulfide
Methanol	MEK	Cyclohexane
Toluene	Pyridine	

Laboratory Safety-Flammable Liquids

Fire Codes-NFPA
Flammable Liquid Storage

Hazardous chemicals stored in the open shall be kept to the minimum necessary for the work being done.

Laboratory Safety-Flammable Liquids

Fire Codes-NFPA
Flammable Liquid Storage
-Safety Cabinets

Laboratory Safety-Flammable Liquids

Fire Codes-NFPA
Flammable
Liquid Storage

Laboratory Safety-Flammable Liquids

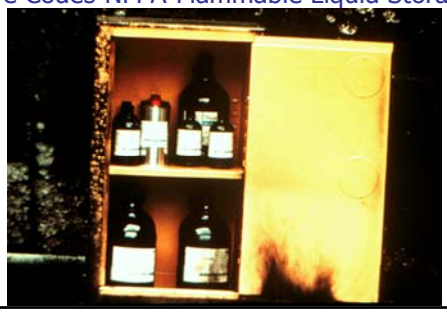
Fire Codes-NFPA-Flammable Liquid Storage

Laboratory Safety-Flammable Liquids

Fire Codes-NFPA-Flammable Liquid Storage

Laboratory Safety-Flammable Liquids

Fire Codes-NFPA-Flammable Liquid Storage



Laboratory Safety-Flammable Liquids

Fire Codes-
NFPA
Flammable
Liquid Storage

Laboratory Safety-Flammable Liquids

Fire Codes-NFPA-Flammable Liquid Storage

Laboratory Safety-Flammable Liquids

Fire Codes-
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Liquid Storage

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Fire Codes-
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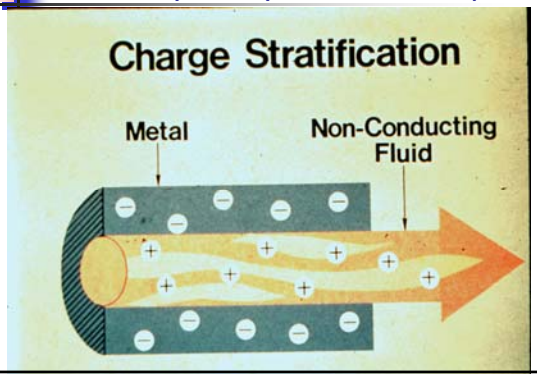
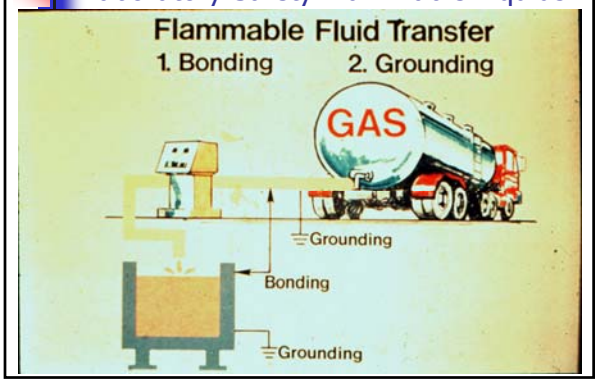
Fire Codes-NFPA-Flammable Liquid Storage

Laboratory Safety-Flammable Liquids



Laboratory Safety-Flammable Liquids



Laboratory Safety-Flammable Liquids

Bonding

And

Grounding

Laboratory Safety-Flammable Liquids

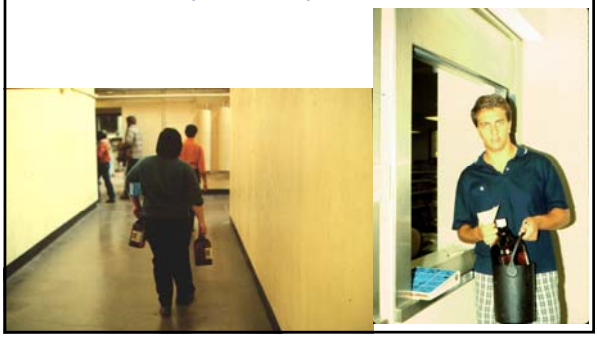
Flammable Liquid Storage in Refrigerators

Laboratory Safety-Flammable Liquids

Accidents Involving Flammable Liquids

Laboratory Safety-Flammable Liquids

Flammable Liquid Transport



Fire Extinguisher Guide

Class A Fires	Class B Fires	Class C Fires	Class D Fires
Fires that involve combustible materials such as **wood**, paper, plastics, and cloth	Fires that involve flammable or combustible **liquids**, gases, greases, and oils	Fires that involve energized **electrical** equipment	Fires that involve certain metals such as **sodium**, magnesium, and potassium
			
Use: Dry Chemical, Water, or Halon Extinguishers	Use: Carbon Dioxide, Halon, or Dry Chemical Extinguishers	Use: Carbon Dioxide or Halon Extinguishers	Use: Special Class D Dry Powder Extinguisher

A Quick Reference Guide for Laboratory Fire Safety

Some rules that you should be familiar with:

1. **You should store more than 10 gallons of Class I and II liquids** outside of an approved storage cabinet. A Class I flammable liquid has a flash point below 100 degrees Fahrenheit. A Class II liquid has a flash point below 140 degrees Fahrenheit. You can store up to 25 gallons of flammable liquids outside of an approved cabinet if you are using safety cans.
2. Safety cabinets do NOT have to be vented. Ventilation is recommended for storage of large quantities of Class I liquids or for malodorous chemicals such as mercaptans.
3. **Extension Cords** are not to be used except for immediate and temporary use (such as running the Mercury Vacuum). Power Strips (those with a separate switch and an internal fuse) CAN be used. Do NOT "daisy chain" power strips to make pseudo-extension cords…this is a dangerous practice.
4. Check power cords to computers and equipment to make sure that they are not damaged or frayed.
5. You CANNOT store materials (such as boxes and books) on top of open shelves **within 24 inches (2 feet) of the ceiling.**
6. **Laboratory doors and other fire doors should remained closed**. Do not block them open with wedges or by disabling automatic closers

Laboratory Safety
Chemical Incompatibilities and Storage

1. Powerpoint Presentation
    a. Inventories
    b. Purchasing
    c. Labeling
    d. Storage
    e. Segregation Tips
    f. Long-Term Storage Considerations
        i. Peroxide Former
        ii. Hygroscopic chemicals
        iii. Chemicals that dry out
        iv. Sublimation
        v. Decomposition
    g. Storage on Open Shelves
    h. What's Wrong With This Picture?
2. Video on Reactive and Explosive Materials
3. Supplemental Information
    a. Incompatibilities Chart
    b. Peroxides
    c. Sample Chemical Hazard Review Form

Web Information

The MSDS Site: http://www.themsds.com
The Canadian Center for Occupational Health and Safety: http://www.ccohs.org/
Chemical Backgrounders from the National Safety Council:
http://www.nsc.org/library/chemical/chemical.htm
OSHA's Chemical Reactivity Page: http://www.osha.gov/dep/reactivechemicals/index.html
EPA Factsheets: http://www.epa.gov/enviro/html/emci/chemref/index.html
Laboratory Chemical Safety Summaries (Howard Hughes Inst):
http://www.hhmi.org/research/labsafe/lcss/index.html
ACS Chemistry Laboratory Information Profiles:
http://membership.acs.org/c/ccs/pubs/CLIPS/default.htm
Berkeley's EH&S Factsheets: http://www.ehs.berkeley.edu/pubs/factandhelp.html
The American Chemical Society: http://www.acs.org/
NOAA Chemical Reactivity Worksheet: http://response.restoration.noaa.gov/chemaids/react.html

Recommended Reading

Prudent Practices in the Laboratory; Handling and Disposal of Chemicals, National Academy Press
Hawley's Condensed Chemical Dictionary, RJ Lewis
Sax's, RJ Lewis
Bretherick's Handbook of Reactive Chemical Hazards, Bretherick
The Merck Index
NIOSH Pocket Guide to Chemical Hazards
Patty's Industrial Hygiene
Physician's Desk Reference

Chemical Storage and Incompatibilities

John Herrington

- Lecture for 20 minutes or so
- Video

Inventories

- Chemical Name
- Original Amount
- Manufacturer (for MSDS')
- Location (at least room number)

Laboratory Safety-Chemical Reactivity

Purchasing (Procurement)

- **Purchase Only the Amount Needed**
- **Purchase Smaller or Custom Containers**
- **Check the Inventory Before Purchase**

Laboratory Safety-Chemical Reactivity

Labeling

- **Label ALL containers**
  - **-Except for Immediate Use**
- **Unknowns are Dangerous and Expensive**
- **Inspect Chemicals and Labels At Least Every 6 Months**
- **Replace Damaged or Worn Labels**
- **Dispose of Chemicals That Have Not Been Used for 12 to 18 Months**

Laboratory Safety-Chemical Reactivity

Storage

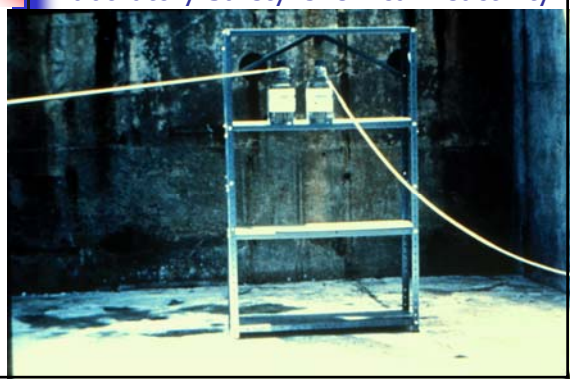
- **Segregate According to Hazard Class**
  - **Acids with Acids, Bases with Bases, etc.**
- **Follow Manufacturers' Recommendations**
  - **-Labels and**
  - **-MSDS**

Laboratory Safety-Chemical Reactivity

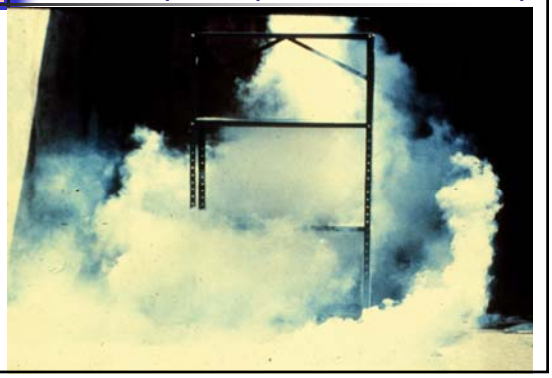
Color-coded Labels for Compatible Storage
The SAF-T-DATA™ label suggests a method for setting up your chemical storage area. The background color indicates the type of storage required. Simply store products with the same color together, except where indicated below, and follow these recommendations for appropriate storage:

Blue	Store in a secure poison area.
Red	Store in a flammable liquid storage area.
Yellow	Store separately and away from flammable or combustible materials
White	Store in a corrosion-proof area.
Green	Store in a general chemical storage area.
Striped	Assess storage individually. A striped label indicates that the material is incompatible with other materials in the same color class.

Laboratory Safety-Chemical Reactivity



Laboratory Safety-Chemical Reactivity



Laboratory Safety-Chemical Reactivity

Segregation Tips

- **Mineral Acids Away From Organic Acids**
- **Organics Away From Oxidizers**
  - **Refer To the Incompatibles Chart**
- **Do NOT Use Alphabetical Order!**
- **Water-Reactive Materials MUST Be Stored Away From All Other Materials**
- **Acute Poisons Should Be Locked**

Laboratory Safety-Chemical Reactivity

Long-Term Storage Considerations

Peroxide Formers

- **Ethers (Isopropyl and Diethyl Ether)**
- **Acetals**
- **Olefins with Allylic Hydrogen**
- **Dienes**
- **Ureas, Amides, Lactams (Sodium Amide)**
- **Alkali Metals and Alkoxides (Potassium)**
- **Vinyl Monomers, Vinyl Halides, Acrylates, Methacrylates (Divinyl Acetylene and Vinylidene Chloride)**

Laboratory Safety-Chemical Reactivity

Long-Term Storage Considerations

Peroxide Formers

- **Date the Containers**
- **Test for Peroxides**
- **Especially before distillation or concentrating**

Laboratory Safety-Chemical Reactivity

Long-Term Storage Considerations

Peroxide Formers

Laboratory Safety-Chemical Reactivity

Long-Term Storage Considerations

Deliquescent / Hygroscopic Chemicals

Laboratory Safety-Chemical Reactivity

Long-Term Storage Considerations

Chemicals That Dry Out

- **-Picric Acid**
- **-Benzoyl Peroxide**

Sublimation

- **-Iodine**
- **-p-Dichlorobenzene**

Decomposition

- **-Hydrogen Peroxide**
- **-Calcium Hypochlorite**

Laboratory Safety-Chemical Reactivity

Other Storage Considerations

Storage On Open Shelves

Laboratory Safety-Chemical Reactivity

What's Wrong With This Picture?

Laboratory Safety-Chemical Reactivity

What's Wrong With This Picture?

Laboratory Safety-Chemical Reactivity

What's Wrong With This Picture?

Laboratory Safety-Chemical Reactivity

What's Wrong With This Picture?

Laboratory Safety-Chemical Reactivity

What's Wrong With This Picture?

Video

"Introduction to Reactive and Explosive Materials

Some Incompatible Materials

Mixing can result in heat, fire, explosion, and/or toxic gases

Acetic Acid	Chromic Acid, nitric acid, hydroxyl-containing compounds, ethylene glycol, perchloric acid, peroxides, and permanganates.
Acetone	Bromine, chlorine, nitric acid, sulfuric acid.
Acetylene	Bromine, chlorine, copper, mercury, fluorine, iodine, and silver.
Alkaline and Alkaline Earth Metals such as calcium, lithium, magnesium, sodium, potassium, powdered aluminum	Carbon dioxide, carbon tetrachloride and other chlorinated hydrocarbons, water, Bromine, chlorine, fluorine, and iodine.
Aluminum and its Alloys (especially powders)	Acid or alkaline solutions, ammonium persulfate and water, chlorates, chlorinated compounds, nitrates, and organic compounds in nitrate/nitrate salt baths.
Ammonia (anhydrous)	Bromine, chlorine, calcium hypochlorite, hydrofluoric acid, iodine, mercury, and silver.
Ammonium Nitrate	Acids, metal powders, flammable fluids, chlorates, nitrates, sulfur and finely divided organics or other combustibles.
Aniline	Hydrogen peroxide or nitric acid.
Bromine	Acetone, acetylene, ammonia, benzene, butadiene, butane and other petroleum gases, hydrogen, finely divided metals, sodium carbide, turpentine.
Carbon (activated)	Calcium hypochlorite, all oxidizing agents.
Caustic (soda)	Acids (organic and inorganic).
Chlorates or Perchlorates	Acids, aluminum, ammonium salts, cyanides, phosphorous, metal powders, oxidizable organics or other combustibles, sugar, sulfides, and sulfur.
Chlorine	Acetone, acetylene, ammonia, benzene, butadiene, butane and other petroleum gases, hydrogen, finely divided metals, sodium carbide, turpentine.
Chlorine Dioxide	Ammonia, methane, phosphine, hydrogen sulfide.
Chromic Acid	Acetic acid, naphthalene, camphor, alcohol, glycerine, turpentine and other flammable liquids.
Copper	Acetylene, hydrogen peroxide.

Cumene Hydroperoxide	Acids
Cyanides	Acids
Flammable Liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, bromine, chlorine, fluorine, iodine.
Fluorine	Isolate from everything.
Hydrocarbons	Bromine, chlorine, chromic acid, fluorine, hydrogen peroxide, and sodium peroxide.
Hydrocyanic Acid	Nitric acid, alkali.
Hydrofluoric Acid	Ammonia, aqueous or anhydrous.
Hydrogen Peroxide (anhydrous)	Chromium, copper, iron, most metals or their salts, aniline, any flammable liquids, combustible materials, nitromethane, and all other organic material.
Hydrogen Sulfide	Fuming nitric acid, oxidizing gases.
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen.
Mercury	Acetylene, alkali metals, ammonia, fulminic acid, nitric acid with ethanol, hydrogen, oxalic acid.
Nitrates	Combustible materials, esters, phosphorous, sodium acetate, stannous chloride, water, zinc powder.
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, flammable gases and liquids, hydrocyanic acid, hydrogen sulfide.
Nitrites	Potassium or sodium cyanide.
Nitro paraffins	Inorganic alkalies.
Oxalic acid	Silver, mercury.
Oxygen (liquid or enriched air)	Flammable gases, liquids, or solids such as acetone, acetylene, grease, hydrogen, oils, phosphorous.
Perchloric Acid	Acetic anhydride, alcohols, bismuth and its alloys, grease, oils or any organic materials and reducing agents.
Peroxides (organic)	Acid (inorganic or organic).
Potassium	Air (moisture and/or oxygen) or water, carbon tetrachloride, carbon dioxide.
Potassium Chlorate	Sulfuric and other acids.

Potassium Permanganate	Benzaldehyde, ethylene glycol, glycerine, sulfuric acid.
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds.
Sodium Chlorate	Acids, ammonium salts, oxidizable materials and sulfur.
Sodium Nitrite	Ammonia compounds, ammonium nitrate, or other ammonium salts.
Sodium Peroxide	Any oxidizable substances, such as methanol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerine, ethylene glycol, ethyl acetate, furfural, etc.
Sulfides	Acids.
Sulfur	Any oxidizing materials.
Sulfuric Acid	Chlorates, perchlorates, permanganates, compounds with light metals such as sodium, lithium, and potassium.
Water	Acetyl chloride, alkaline and alkaline earth metals, their hydrides and oxides, barium peroxide, carbides, chromic acid, phosphorous oxychloride, phosphorous pentachloride, phosphorous pentoxide, sulfuric acid, sulfur trioxide.

Peroxides

Peroxy compounds are examples of chemicals which present special problems In the laboratory because they can be violently reactive or explosive. Their handling deserves careful attention.

Inorganic Peroxides

Inorganic peroxy compounds are generally stable as such, but in contact with organic compounds may generate organic peroxides and hydroperoxides. Their contact with any combustible material may lead to afire or explosion.
They must be stored, handled and used with much caution. Peroxides of alkali metals are not sensitive to shock, but are decomposed slowly by moisture and violently by bulk water. The most common inorganic peroxy compounds are sodium peroxide, hydrogen peroxide, sodium perborate, and sodium persulfate. The high weight alkali metals readily form superoxides, and ozonides such as KO_3 are known.
Any of these peroxy compounds can pose a threat of fire or explosion when contacted by oxidizable materials. They can react violently with water and many other substances. Small spills can be treated cautiously with water and sodium bisulfite solution; larger ones should be taken up with inert solids such as vermiculite, sand or salt and treated with bisulfite in a safe area. Any person burned by these chemicals should be washed gently but thoroughly and given competent medical attention.

Organic Peroxides and Hydroperoxides

Organic peroxy compounds fail largely into four classes: dialkyl or diarylalkyl peroxides, peracids, diacyl peroxides, and alkyl or arylalkyl hydroperoxides. All are unstable to some degree and generally are not offered in high purity for their hazards increase with concentration. The hazard decreases with increasing molecular weight because of the dilution effect. Those of lower molecular weight can deflagrate or detonate. Some of the most common ones are tert-butyl peroxide, tert-butyl hydroperoxide, peracetic acid, benzoyl peroxide and iso-propylbenzene (cumene)hydroperoxide.
Because peroxy compounds are unstable and decompose continuously, bulk quantities may generate enough heat to autoaccelerate up to ignition or explosion. They are sensitive to heat, friction, impact and light as well as to strong oxidizing and reducing agents. All organic peroxides are quite flammable and fires involving bulk quantities should be approached with extreme caution. Because they can generate free radicals with catalytic power, their presence as a contaminant in a reaction mixture can change the course of a planned reaction.
Organic peroxy compounds are generally more stable when water is present. For example, benzoyl peroxide is a solid (m.p. 104-106 dec.) which can ignite or explode from heat, impact or friction, and which must be kept moist in storage. The unscrewing of a lid covered with the dry chemical can set off the entire lot. No more than a short term supply should be kept on hand and the container must be checked at regular intervals. If in doubt, it is best to call an expert on disposal of dangerous chemicals.

Peroxide Formers and Their Storage and Handling

Peroxide formers react with oxygen even at low concentrations and ordinary temperatures to form peroxy compounds which are usually hydroperoxides. In addition to any other hazards that they have, they pose a "peroxide threat" especially if the oxygenated product crystallizes out or becomes concentrated by evaporation or distillation of the unoxidized part. Peroxide crystals may even form at the threads of a sealing plug or cap.

There are four main groups of compounds known to be peroxide precursors:

- Ethers with primary and/or secondary alkyl groups, including open chain and cyclic ethers, acetals and ketals
- Hydrocarbons with allylic, benzylic or propargylic hydrogens
- Conjugated dienes, eneynes and diynes
- Saturated hydrocarbons with exposed tertiary hydrogens

Some specific and typical examples are diethyl ether, di-isopropyl ether, tetrahydrofuran (THF), p-dioxane, cyclohexane, isopropylbenzene (cumene), tetrahydronaphthalene (tetralin), divinylacetylene, decahydronaphthalene and 2,5-dimethylhexane.

Peroxidation is generally a problem of the liquid state. Solid peroxide formers present little problem except when finely divided, for the reaction, if any, will occur only at the surface. Peroxidation seems to be no problem within gases and vapors. For liquids, the peroxidation typically occurs when containers are not fully sealed and blanketed with inert gas. Breathing then occurs with changes in temperature and barometric pressure and oxygen gets into the containers. Peroxide buildup is usually slow because the exchange of atmosphere containing only twenty percent oxygen is usually slow.

If abundant oxygen is supplied to a fast peroxide former, typically there is an induction period, then a relatively fast accumulation of hydroperoxide which tapers off at a maximum level, perhaps 5-15%. Then, the concentration will stabilize or even decrease because the hydroperoxide itself undergoes decomposition and forms byproducts such as alcohols and water which interfere with the free radical chain reaction or peroxidation. The byproduct content may continue to grow, but the peroxide content does not. CAUTION: This scenario does not apply when peroxides separate in solid form. Then the peroxy substance is undiluted by solvent or byproducts and is an immediate threat.

Peroxide formers cannot form peroxy compounds without exposure to oxygen or oxidizers. Therefore their containers should always be tightly sealed. Air should always be flushed out of the free space with an inert gas (usually nitrogen) before sealing. Plastic caps, stoppers and plugs should be used to reduce corrosion and friction.

Precautions for storing and handling peroxide formers are summarized here:

(a) Label the chemicals as known peroxide formers or (in some cases) as possible peroxide formers.

(b) Limit the stock of any item to three months supply or less, and discard remaining stock unless found to be essentially peroxide free.

(c) Always maintain an inert atmosphere (nitrogen or argon) In the free space of each container. Either flush with a stream of the gas, or use pressure siphoning with the gas when withdrawals are made.

(d) Unless It would compromise the material's usefulness, add an oxidation inhibitor to ft. The recommended amount is from 0.001 to 0.01% of inhibitors such as hydroquinone, 4-tert-butylcatechol (TBC) or 2,6-di-tert-butyl-p-methylphenol (BHT).

(e) Before distilling any known or suspected peroxide former, check it carefully for peroxide. If any is present, eliminate it by chemical treatment or percolation, or add an inert high boiling substance (such as mineral oil) to prevent the peroxide from concentrating to a dangerous level.

A variety of chemicals used as solvents or in synthesis, even alcohols, have been found to contain significant amounts of peroxides (as high as 0.1 percent). Such small amounts could arise from impurities which are peroxide formers. However, a severe laboratory explosion in the distillation of 2-propanol has been attributed to peroxide content. Pending further investigation, prudence suggests that all oxidizable organic liquids should be checked for peroxides before distillation or use in reactions sensitive to peroxide catalysis.

Detection and Determination of Peroxides

The presence of most peroxy compounds, including all hydroperoxides, can be detected by this test: Mix 1-3 mL of the liquid to be tested and an equal volume of acetic acid in a test tube, add a few drops of five percent potassium iodide solution, and shake. The appearance of a yellow-to-brown color indicates presence of a peroxide. If the color is faint, run a blank to make sure the test is really positive. A semi-quantitative testing kit using treated paper strips is available. Quantitative titration procedures are available.

Disposal of Peroxides

CAUTION. Only a "bomb squad" should dispose of pure peroxides. Peroxides normally must be diluted before disposal.
Small quantities (25 g or less) of peroxides are generally disposed of by diluting with water to a concentration of 2% or less and then transferring them to a polyethylene disposal bottle containing an aqueous solution of a reducing agent such as ferrous sulfate or sodium bisulfite. The material is then handled like any other waste chemical, but it must not be mixed with other chemicals for disposal. Spilled peroxides should be absorbed on vermiculite as quickly as possible. The vermiculite-peroxide mixture may then be burned directly or may be stirred with a suitable solvent to form a slurry, which is then treated as above. CAUTION: Never flush organic peroxides down the drain.
Large quantities (more than 25 g) of peroxide require special handling. Each case should be considered separately and a handling, storage and disposal procedure, determined by the physical and chemical properties of the particular peroxide and prevailing regulations, established. In Preparing a disposal procedure, consult "Destroying Peroxides of Isopropyl Ether," by A. C. Hamstead, Ind. Eng. Chem., 1964, 56(6), 37.

Reprinted from "Safety in Academic Chemistry Laboratories." Published by The American Chemical Society.

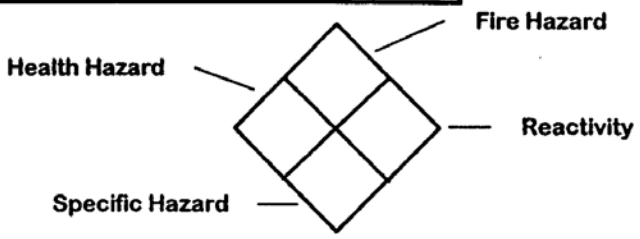
SAF-30 New Chemical Hazard Review

Form E-1

Chemical Name
Trade Name
CAS Number
Molecular Formula
Form or Appearance
Unusual Hazards ?
Specific Personal Protective Equipment?
PEL Monitoring Required?
Threshold Value for Reporting
SPILLS / RELEASES STORAGE
Storage / Use Location

Time Sensitive Material?	☐ Yes ☐ No
Date Received:	
Expiration Date:	

NFPA HAZARD CLASSIFICATION



Material Class

- ☐ Irritant ☐ Corrosive
- ☐ Allergen ☐ Asphyxiant
- ☐ Developmental & Reproductive Toxin
- ☐ Carcinogen ☐ Neurotoxin
- ☐ Organ Specific Toxin

Other Hazards

- ☐ Flammable (Flash Point < 100F)
- ☐ Combustible (Flash Point > 100F)
- ☐ Shock Sensitive
- ☐ Pyrophoric
- ☐ TSCA Listed

New Chemical Storage & Handling Requirements:

Incompatible Materials in Laboratory (Use location) / Storage Location

Material	Storage / Use Location	Adverse Potential

(continue on back)

Person Initiating: PRINT SIGNATURE	**Date (m/d/y)**
Qualified Approval: PRINT SIGNATURE	**Date (m/d/y)**

Form E-2

Incompatible Materials in Laboratory (Use location) / Storage Location		
Material	**Storage / Use Location**	**Adverse Potential**

Qualified Reviewers Comments:

Suggested References:

I. Bretherick, L., 1990. Bretherick's Handbook of Reactive Chemical Hazards, 4th ed., London: Butterworth.
II. National Fire Protection Association (NFPA). 1991. Fire Protection Guide to Hazardous Materials, 10th ed. Quincy Mass. : NFPA.
III. Bretherick, L. Ed. 1986. Hazards in the Chemical Laboratory, 4th ed. Cambridge, UK : Royal Society of Chemistry.
IV. 1995. Prudent Practices in the Laboratory: Handling and Disposal of Chemicals, Washington D.C. : National Academy Press.

Laboratory Safety
Summary: Laboratory Inspections

1. Powerpoint Presentation
    a. Emergency Equipment
    b. Fume Hoods
    c. Hazardous Waste and Spill Control
    d. PPE
    e. Chemical Storage
    f. Electrical Safety
    g. Flammable Liquids and Fire Codes
    h. Misc
2. Supplemental Information
    a. Sample Monthly Inspection Check List

Web Information

Ohio State University Department of Chemistry Safety Page (http://www.chemistry.ohio-state.edu/ehs/)
Ohio State University Office of EHS (http://www.ehs.ohio-state.edu/)
OSU College of Biological Sciences Safety Page (http://www.biosci.ohio-state.edu/~jsmith/SafetyPage.htm)

Link Pages:

http://www.chemistry.ohio-state.edu/ehs/links.htm

http://www.biosci.ohio-state.edu/~jsmith/Big10/big10s~2.htm

http://www.ehs.ohio-state.edu/index.asp?PAGE=ehs.links

Laboratory Safety-Laboratory Inspections

Emergency Equipment

Laboratory Safety-Laboratory Inspections

Emergency Equipment

Laboratory Safety-Laboratory Inspections

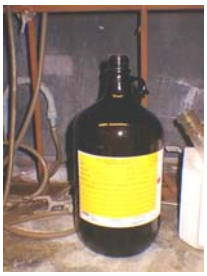
Fume Hoods

Laboratory Safety-Laboratory Inspections

Fume Hoods

Laboratory Safety-Laboratory Inspections

Hazardous Waste and Spill Control



Laboratory Safety-Laboratory Inspections

Hazardous Waste and Spill Control

Laboratory Safety-Laboratory Inspections

Personal Protective Equipment

Laboratory Safety-Laboratory Inspections

Chemical Storage

Laboratory Safety-Laboratory Inspections

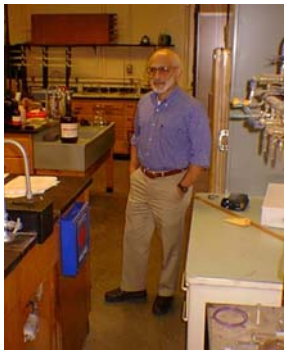
Chemical Storage

Chemical Storage

Check to see if any CARCINOGENS, REPRODUCTIVE TOXINS OR HIGHLY HAZARDOUS MATERIALS are being used.

If so, there should be a DESIGNATED AREA for their use.

Electrical Safety



Flammable Liquids and Fire Codes

Miscellaneous

B-Building Monthly Lab Inspection FORM L

"Person Responsible" required to: (1) make corrective action(s), (2) sign and **retain** this copy for laboratory records

Location	B93 - B96 MIC	Person Responsible	ch
Inspection Team	John Adamski, Bob Radvice	Date	January 2001

Please rate each subcategory as Satisfactory (S) or Unsatisfactory (U)

One or more "U" in each category results in subtracting "1" from total score	S	U	REQUIRED CORRECTIVE ACTION (To be completed within one month)	COMPLETE (Initials)
NOTE: INCLUDE			**S OFFICE AREAS ON THIS SHEET**	
1. Safety Equipment/PPE				
Extinguisher Mounting	___	___		
Exting, Inspection Tag Current	___	___		
Eyewash Test	___	___		
Eyeware/Sideshields	___	___		
Steel Toe Shoes	___	___		
Proper gloves/selection awareness	___	___		
Hood inspection current (within 12 mths)	___	___		
2. Chemical Storage & Labeling				
MSDS File **(located in B-93)**	___	___		
SAF Book **(located in B-93)**	___	___		
Proper Labeling	___	___		
Storage Compatibility	___	___		
Proper Containers	___	___		
Proper Chem Storage	___	___		
Time Sensitive Materials	___	___		
3. Housekeeping				
Hoods/Benches Uncluttered	___	___		
Trash Storage	___	___		
Glassware Storage	___	___		
Clean Floor	___	___		
Needles/Blades Protected	___	___		
General Storage	___	___		
4. Obstructions/Access				
Aisleways/Exits Clear	___	___		
Extinguisher Access	___	___		
Eyewash/Sprinkler Access	___	___		
Elec./Control Panel Access	___	___		
5. Gases				
Relief Valves Certified	___	___		
Cylinders Properly Secured	___	___		
Storage Compatibility	___	___		
Portable Electric Equip.	___	___		
6. Other				
Weekly Inspection **(located in B-93)**	___	___		
SOP annual Review	___	___		
Radiation Control Prog. Ck.	___	___		
Spill Kit	___	___		

Total Score** (please circle)* **Worst** ***0 1 2 3 4 5 6 **Best** *use reverse side for additional comments*

Corrective Action Verified _____

Manager Responsible **Date**