# Laboratory Safety and Health

# Best Practices for Laboratory Safety

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Prepared by the Safety and Health Department
United Federation of Teachers
A Union of Professionals

Conducted Under a UFT Grant
NYSDOL HAB

United Federation of Teachers
A Union of Professionals

Laboratory Specialist
Health and Safety

**Curriculum**

DOE Mercury Fact Sheet
    Removal Procedures

Unwanted Chemical Removal
    Chemical Removal Form

CDC Chemical Storage Guidelines
    Labeling, Segregation/storage pattern
Spill Control Kit - putting together your own
Preventing Accident, Theft & Vandalism
Laboratory Safety Rules

OSHA 29CFR 1910.1450
    Food and Drink in Labs – REGULATIONS & STANDARDS OF CARE
    Poster

Fire Extinguisher Classification 101
Lab Safety Equipment
    Eye Wash and Safety Showers Information
Safe Handling of Alcohol in the Lab
Fume Hood Safety
Safety Tips for Lab Refrigerators and Lab Freezers

Department of Education

Office of Occupational Safety and Health
718-935-2319 I www.schools.nyc.gov/offices/DHR/OSH

## MERCURY REMOVAL IN SCHOOLS

Mercury is a silver-colored, liquid metal that occurs naturally in the earth's surface. Mercury was used for many years in measurement intruments used by schools, primarily in science labs but also in the nurse's office, gymnasiums, and boiler rooms. Schools should ensure that staff members understand the dangers associated with mercury and follow the specified protocols below if mercury is located or spilled.

**WHERE IS MERCURY FOUND IN SCHOOLS?** Liquid mercury is used in measurement instruments including thermometers, barometers, sphygmomanometers, sling psychrometer, hygrometers, laboratory manometers, anemometers, etc. Mercury can also be found in lights (particularly gymnasium and fluorescent lights), thermostats, heating/ventilation and air conditioning (HVAC) systems, plumbing, cafeteria equipment and medical devices.

**WHY IS MERCURY DANGEROUS?** Mercury's properties are toxic and allow it to break into small droplets and vaporize. Mercury can be absorbed through the skin, lungs or intestinal tract in either liquid or gaseous form and can affect the central nervous system, resulting in memory loss, headache, sleeplessness, irritability, and tremors. Short-term exposure to high levels can also cause coughing, shortness of breath, chest pain, nausea, vomiting, diarrhea, fever, high blood pressure and skin rashes. In 2004, New York State banned the purchase of elemental mercury in schools.

**WHAT SHOULD A SCHOOL DO TO PREVENT MERCURY EXPOSURE?** Schools should inform staff that instruments containing mercury may be present in the school. Staff members should thoroughly inspect rooms for instruments or containers that house mercury.

**WHAT SHOULD A SCHOOL DO IF MERCURY IS LOCATED?** Do not handle, move, or remove items containing mercury. Mercury requires professional disposal and can cause hazardous conditions and expensive damage if it is discarded or poured down the drain.

1. Use the *inventory form* to document the location of any equipment containing mercury.
2. Provide the form to your custodian who should prepare a Passport work request for mercury removal, using Trade Code 75.
3. The DOE Deputy Director of Facilities (DDF) will approve the work request and have a work order prepared for removal by a professional waste removal company.
4. The professional waste removal company will use the inventory to locate and remove mercury sources, and may conduct an assessment of the area where the mercury was found to determine whether it has spilled.

**WHAT SHOULD A SCHOOL DO IF MERCURY SPILLS?**

1. Do not touch it or attempt to clean it up.
2. Evacuate the area immediately.
3. Close and lock the door to the affected area.
4. Immediately notify the principal and custodian, who will arrange for professional clean-up.

**WHAT SHOULD SCHOOLS DO TO REPLACE EQUIPMENT WITH NON-MERCURY ALTERNATIVES?** Schools should ensure that devices containing mercury are handled professionally, in accordance with the protocols decsribed above. Schools can replace devices with alternatives that do not contain mercury.

| DEVICES CONTAINING MERCURY | REPLACEMENT ALTERNATIVES |
|---|---|
| Lab thermometer | Alcohol glass bulbs, mineral spirits glass bulbs, or digital. |
| Barometer | Aneroid or digital; new liquid one is being developed. |
| Spectrum tube | Ask your scientific supplies distributor for a list of alternative gases |
| Gas law apparatus | A simple Charles' Law Apparatus may suffice. |
| Anemometer | Digital versions are available. |
| Other metallic mercury containing instruments | Check with the original manufacturer for contents of older devices and components; they may have a swap-out program available. Non-mercury alternatives are available for most instruments. Additional information is available at: http://www.epa.gov/ginpo/seahome. |

Removal Procedures for
Mercury & Mercury containing products/equipment

1. Inventory:
During the course of your annual chemical inventory make special note of any elemental mercury in your storage areas. Look for glass jars, bottles, vials that may contain mercury.
During the course of your annual equipment inventory make note of thermometer, barometers, hygrometers, vacuum gauges, steokel tubes, sling psychrometers, gas law apparatus, anemometers, blood pressure equipment – that may contain mercury.

2. Make note on the inventory form of the
- number/amount of items,
- location (room, cabinet, drawer etc),
- number of non-mercury replacements needed
- **tag or identify the items with an obvious marking *

3. Complete the chemical removal form. Be sure to include all necessary information. Make a copy for your administrator and keep a copy for your records .

4. Pass the completed form on to your principal, administrator or custodian for processing.

5. *** Do not move or remove mercury containing items yourself – the professional removal company will do this.**

## How to have unwanted chemicals and chemical waste removed

- During the course of your annual chemical inventory take note of any chemicals that should be considered for removal. **Any and all mercury and mercury containing devices** should be included in removal as per the 2004 New York State law which prohibits the storage, use and purchase of mercury and mercury-containing devices in primary and secondary schools.
- Inform your Assistant Principal of any chemicals that are old, in excess of what is needed, & have deteriorating containers.
- Biological specimens that are not properly sealed and are off gassing should be included with other unwanted chemicals.
- Confer with the Assistant Principal and grade leaders/teachers to ascertain which chemicals and specimens need to be removed and disposed of properly. Any and all mercury must be removed.
- Use the "Chemical Removal Form" to complete the list.
- When completing the form be as specific as possible as to the number, and sizes of containers that are to be removed. Any unidentified chemicals should be included on the list as " unknown" or waste.
- **Do not pack or move the chemicals or mercury containing devices yourself. Identify the container for removal with a mark or tag.** Once tagged/marked the assistant principal and custodian should be shown where these items are located.
- When the list is completed the Assistant Principal will ask the custodian to prepare a PO 18 request for chemical removal, attaching the prepared list(s) of chemicals.
- PO 18 request should use Trade Code 75 Crew # IN27 Job type EB.
- The custodian then contacts the DOE Deputy Director of Facilities (DDF) to prepare a work order for removal.
- Keep a copy of the request and list(s) in your files.
- The DOE Deputy Director of Facilities (DDF) manager will also **fax** the request to the attention of M. Pedram at 718-361-3844.

In the event of a chemical release or spill (for example mercury) immediately call the UFT Health and Safety Department at 212-701-9407, the DOE Office of Occupational Safety and Health at 718-935-2319, and the DOE Division of School Facilities Environmental Safety and Health Department at 718-361-3808. Follow notification procedures for your school.

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- Make as many copies of this form as needed.
- Attach the form(s) to a PO I8 request
- Keep a copy for your records

**Fax to:** (718) 361-3844
Att: M. Pedram

***Via Passport System***
***Notify M. Pedram***

Use: **Trade Code 75 – Crew# IN27 – job type EB** on the PO I8 request.

# Chemical Removal Request Form

**School:**_____

**Address:**_____

**Borough:**_____**Zip Code:**_____-_____

**Date:**_____

| **Name of chemical** | **Number x Size = Total** | **Room No.** |
|---|---|---|
| _____ | _____**x** ____**=**_____ | _____ |
| _____ | _____**x** ____**=**_____ | _____ |
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| _____ | _____**x** ____**=**_____ | _____ |

**Principal's Signature:**_____

**Contact Person:**_____ **Telephone:(____)**_____
**Custodian:**_____**Telephone:(____)**_____

# Chemical Storage Guidelines from the CDC

If you need a set of chemical storage guidelines meet OSHA and safety needs in your lab, school, manufacturing or storage facility, this page should provide the template you need.

## Guidelines for Safe Chemical Storage

Safe chemical handling requires routine inspections of chemical storage areas and maintenance of stringent inventory control. The inherent hazards of chemicals can be reduced by minimizing the quantity of chemicals on hand. However, when chemicals must be used, proper storage and handling can reduce or eliminate associated risks. All chemical storage areas and cabinets should be inspected at least annually and any unwanted or expired chemicals should be removed.

Typical storage considerations may include temperature, ignition control, ventilation, segregation and identification. Proper segregation is necessary to prevent incompatible materials from inadvertently coming into contact. A physical barrier and/or distance is effective for proper segregation.

Proper storage information can usually be obtained from the Material Safety Data Sheet (MSDS), label, or other chemical reference material. As required by 29 CFR 1910.1200, an MSDS must be on hand for every hazardous chemical in your workplace. MSDSs must be provided by the manufacturer or distributor of chemicals purchased. MSDSs are also available through the LINDEN system, CDC's Chemical Tracking System. This system tracks CDC's chemical inventory and includes MSDSs for most chemicals in the inventory. The Internet can also be used to find MSDSs. For a fast search for an MSDS on the Internet, go to the CDC Intranet, select "Databases", then select "Scientific Information", and then "Material Safety Datasheets". This site provides specific manufacturer information as well as generic information.

# Keys for safe chemical storage:

- Ensure all containers of hazardous chemicals are properly labeled with the identity of the hazardous chemical(s) and appropriate hazard warnings.

- Segregate all incompatible chemicals for proper storage of chemicals by hazard class. In other words, store like chemicals together and away from other groups of chemicals that might cause reactions if mixed.
- Do not store chemicals alphabetically except within a grouping of compatible chemicals.
- Flammable materials should be stored in an approved, dedicated flammable materials storage cabinet or storage room if the volume exceeds ten gallons. Keep cabinet doors closed.

- Chemicals should be stored no higher than eye level and never on the top shelf of a storage unit. Do not overcrowd shelves. Each shelf should have an anti-roll lip.
- Avoid storing chemicals on the floor (even temporarily) or extending into traffic aisles.
- Liquids should be stored in unbreakable or double-contained packaging, or the storage cabinet should have the capacity to hold the contents if the container breaks.
- Store acids in a dedicated acid cabinet. Nitric acid may be stored there also but only if it is kept isolated from all other acids.
- Store highly toxic or controlled materials in a locked, dedicated poison cabinet.
- Volatile or highly odorous chemical shall be stored in a ventilated cabinet. Chemical fume hoods shall not be used for storage as containers block proper air flow in the hood and reduce available work space.
- All chemicals should be labeled and dated upon receipt in the lab and on opening. This is especially important for peroxide-forming chemicals such as ethers, dioxane, isopropanol, and tetrahydrofuran. Solutions should be labeled and dated when prepared.
- Look for unusual conditions in chemical storage areas, such as:

    - Improper storage of chemicals
    - Leaking or deteriorating containers
    - Spilled chemicals
    - Temperature extremes (too hot or cold in storage area)
    - Lack of or low lighting levels
    - Blocked exits or aisles
    - Doors blocked open, lack of security
    - Trash accumulation
    - Open lights or matches
    - Fire equipment blocked, broken or missing
    - Lack of information or warning signs ("Flammable liquids", "Acids", "Corrosives", "Poisons", etc.)

- First aid supplies, emergency phone numbers, eyewash and emergency shower equipment, fire extinguishers, spill cleanup supplies and personal protective equipment should be readily available and personnel trained in their use.
- Chemicals stored in explosion-proof refrigerators or cold rooms shall be sealed and labeled with the name of the person who stored the material in addition to all other required hazard warnings.
- Only compressed gas cylinders that are in use and secured in place shall be kept in the laboratory. All others, including empties, shall be sent to the compressed gas cylinder storage area for the particular facility.
- Keep all stored chemicals, especially flammable liquids, away from heat and direct sunlight.

# Chemical Labeling

- All containers must be labeled
  - Includes wash bottles, reagent bottles, and other chemical containers
- Labels must identify contents
- Should date containers when received and opened
  - Dispose of expired and old chemicals

# Chemical Segregation

- Store chemicals according to hazard class
- Do not store chemicals by:
  - Alphabetically
  - Carbon number (organic chemicals)
  - Liquids versus solids
  - Small bottles versus large bottles
  - Whatever fits on the shelf
- Until chemicals have been segregated

# Color Coding


**RED** - Flammable and combustible. Store separate from other chemicals.

**YELLOW** - Oxidizer. Store away from flammables.

**BLUE** - Health Hazard - Toxic. Store in secure area.

# Chemical Hygiene Plan

- Chemical Hygiene Plan (CHP) needs to be readily available
  - Required by PESH and FDNY
  - Recommend keeping hard copy in lab

# Material Safety Data Sheets

- Responsibility of supervisors to ensure MSDSs are accessible
  - Paper or electronic format
  - Should be able to produce a MSDS within 5 minutes

# Suggested Chemical Storage Pattern

Storage of laboratory chemicals presents an ongoing safety hazard for school science departments. There are many chemicals that are incompatible with each other. The common method of storing these products in alphabetical order sometimes results in incompatible neighbors. For example, storing strong oxidizing materials next to organic chemicals can present a hazard.

A possible solution is to separate chemicals into their organic and inorganic families and then to further divide the materials into related and compatible families. Below is a list of compatible families.

## INORGANIC

1. METALS, HYDRIDES
2. ACETATES, HALIDES, IODIDES, SULFATES, SULFITES, THIOSULFATES, PHOSPHATES, HALOGENS
3. AMIDES, NITRATES, (EXCEPT AMMONIUM NITRATE) NITRATES, AZIDES
4. HYDROXIDES, OXIDES, SILICATES, CARBONATES, CARBON
5. SULFIDES, SELENIDES, PHOSPHIDES, CARBIDES, NITRIDES
6. BROMATES, CHLORATES, PERCHLORATES, PERCHLORIC ACID, CHLORITES, HYPOCHLORITES, PEROXIDES, HYDROGEN PEROXIDE
7. ARESENATES, CYANIDES, CYANATES
8. BORATES, CHROMATES, MANGANATES, PERMANGANATES
9. ACIDS (EXCEPT NITRIC)
   (Nitric Acid is isolated and stored by itself.)
10. SUL FUR, PHOSPHORUS, ARSENIC, PENTOXIDE

## ORGANIC

1. ACIDS, ANHYDRIDES, PERACIDS
2. ALCOHOLS, GLYCOLS, AMINES, AMIDES, IMINES, IMIDES
3. HYDROCARBONS, ESTERS, ALDEHYDES
4. ETHERS, KETONES, KETENES, HALOGENATED HYDROCARBONS, ETHYLENE OXIDE
5. EPOXY COMPOUNDS, ISOCYANATES
6. PEROXIDES, HYDROPEROXIDES, AZIDES
7. SULFIDES, POLYSULFIDES, SULFOXIDES, NITRILES
8. PHENOLS, CRESOLS

## Putting together your own SPILL CONTROL KIT

Spill control kits are only to be used for small spills. If you do not have the materials or equipment do not attempt cleanup and follow procedures that your school has in place.

- Bucket of sand to contain a spill (available from hardware store or from you custodian) Remember sand is poor absorbent.
- Bucket of plain kitty litter (absorbent) available at the grocery store
- Bucket of vermiculite (absorbent), be sure it is asbestos free
- Bucket of Sodium Carbonate ($Na_2CO_3$ )for neutralizing an acid spill
- Vinegar to neutralize alkaline spills
- Acid or base absorbent pillows, booms or pads (available from your science supplier)
- Mercury spill kits are NOT to be used. Follow DOE procedures for mercury spills.
- Plastic broom, dust pan, plastic bags
- Paper towels, news papers, old rags
- An over pack container with a lid - that would be a container you place the neutralized materials in for the custodian to remove
- A marker for labeling waste
- Gloves, apron, face shield any personal protective equipment that may be required
- Keep your school safety plan easily accessible in case of emergencies

## Suggestions for preventing accidents theft and vandalism in the Lab

- Students should be provided with a list of laboratory safety rules in the form of a safety contract signed by the student.
- Signs could be posted in the laboratory regarding care and use of the facility and the equipment.
- Keep the lab door closed and locked after the beginning bell.
- Do not place equipment or chemicals on the counters or on carts near the exit doors.
- Teachers should assign students specific seats in lab.
- Students should not be allowed to roam around the lab room while lab is in session.
- A count and list of laboratory materials should be provided to the lab teacher.
- Teacher could assign a student as the "materials manager" for each lab table.
- No food, drink or gum permitted in the lab.
- Students should never be left unattended.
- Students should be required to sign a bathroom pass log book.
- Students could be required to leave their ID card with the teacher when using or borrowing expensive equipment for the lab exercise.
- Teachers should account for all equipment and supplies at clean up time using the list you provided.
- Modes of emergency communication should be functioning.

## LABORATORY SAFETY RULES

1. Report all accidents, injuries, and breakage of glass or equipment to instructor immediately.

2. Keep pathways clear by placing extra items (books, bags, etc.) on the shelves or under the work tables. If under the tables, make sure that these items can not be stepped on.

3. LONG HAIR (CHIN LENGTH OR LONGER) MUST BE TIED BACK to avoid catching fire.

4. Wear sensible clothing including footwear. Loose clothing should be secured so they do not get caught in a flame or chemicals.

5. WORK QUIETLY - know what you are doing by READING the assigned experiment BEFORE you start to work. Pay close attention to any CAUTIONS described in the laboratory exercises.

6. DO NOT TASTE OR SMELL CHEMICALS.

7. Wear SAFETY GOGGLES to protect your eyes when heating substances, dissecting, etc.

8. Do not attempt to change the position of glass tubing in a stopper.

9. NEVER point a test tube being heated at another student or yourself. Never look into a test tube while you are heating it.

10. UNAUTHORIZED experiments or procedures MUST NOT be attempted.

11. Keep solids out of the sink.

12. Leave your work station clean and in good order before leaving the laboratory.

13. Do not lean, hang over or sit on the laboratory tables,

14. Do not leave your assigned laboratory station without permission of the teacher.

15. Learn the location of the fire extinguisher, eye wash station, first aid kit and safety shower.

16. **FOOLING AROUND OR "HORSE PLAY" IN THE LABORATORY IS ABSOLUTELY FORBIDDEN. STUDENTS FOUND IN VIOLATION OF THIS SAFETY RULE WILL BE BARRED FROM PARTICIPATING IN FUTURE LABS AND COULD RESULT IN SUSPENSION.**

17. Anyone wearing acrylic nails will not be allowed to work with matches, lighted splints, bunsen burners, etc.

18. Do not lift any solutions, glassware or other types of apparatus above eye level.

19. Follow all instructions given by your teacher.

20. Learn how to transport all materials and equipment safely.

**NO EATING OR DRINKING IN THE LAB AT ANYTIME!!!**

## FOOD AND DRINK IN LABS — REGULATIONS & STANDARDS OF CARE

**REGULATIONS:**

**OSHA's Sanitation Standard - 29CFR1910.141**

"(g) Consumption of food and beverages on the premises. . . .
(2) Eating and drinking areas. - No employee shall be allowed to consume food or beverages in a toilet room nor in any area exposed to a toxic material."

**OSHA's Bloodborne Pathogens Standard - 29CFR1910.1030**

"(d) Methods of Compliance.- . . .

(ix) Eating, drinking, smoking, applying cosmetics or lip balm, and handling contact lenses are prohibited in work areas where there is a reasonable likelihood of occupational exposure.

(x) Food and drink shall not be kept in refrigerators, freezers, shelves, cabinets or on countertops or bench tops where blood or other potentially infectious materials are present.

**LICENSING REQUIREMENT(S):**

**Radioactive Material User's Guide — Rules for Use of Radioactive Material**
"Eating, drinking, smoking, the application of cosmetics or other similar activities which could lead to the uptake of radiation contamination are prohibited n areas where unsealed radioactive materials are being used".

**NOTE:** These rules must be followed by all users of radioactive materials due to a condition in our broad license.

**STANDARDS OF CARE:**

**National Research Council's Prudent Practices in the Laboratory, 1995.**

**"5.C.2.2 Avoiding Ingestion of Hazardous Chemicals**
Eating, drinking, smoking, gum chewing, applying cosmetics, and taking medicine in laboratories where hazardous chemicals are used should be strictly prohibited. Food, beverages, cups, and other drinking and eating utensils should not be stored in areas where hazardous chemicals are handled or stored. Glassware used for laboratory operations should never be used to prepare or consume food or beverages. Laboratory refrigerators, ice chests, cold rooms, ovens, and so forth should not be used for food storage or preparation. Laboratory water sources and deionized laboratory water should not be used for drinking water.

**5E-1 Biohazardous Materials**
Never eat, drink, smoke, handle contact lenses, apply cosmetics, or take or apply medicine in the laboratory.

**5E-2 Radioactive Materials**
Never eat, drink, smoke, handle contact lenses, apply cosmetics, or take or apply medicine in the laboratory, and keep food, drinks, cosmetics, and tobacco products out of the laboratory entirely so that they cannot become contaminated.

**CDC/NIH Biosafety in Microbiological and Biomedical Laboratories**

"Standard Microbiological Practices" for ALL Biosafety Level 1- Level 4 labs include the following:

> 3. Eating, drinking, smoking, handling contact lenses, and applying cosmetics are not permitted in the work areas where there is reasonable likelihood of exposure to potentially infectious materials. Food is stored outside the work area in cabinets or refrigerators designated for this purpose only.

**OSHA's Occupational exposure to hazardous chemicals in laboratories - 29CFR1910.1450 Appendix A - National Research Council Recommendations (1981) Concerning Chemical Hygiene in Laboratories (Non-Mandatory)**

"E. Basic Rules for Working with Chemicals

1. General Rules

(D) Eating Smoking, etc.: Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where laboratory chemicals are present; wash hands before conducting these activities.

Avoid storage, handling, or consumption of food or beverages in storage areas, refrigerators, glassware or utensils which are also used for laboratory operations.

NYC Department of Education

Joel Klein
Chancellor

# Laboratory Safety and Health Standard

## 29 CFR 1910.1450

## Each NYC DOE facility must comply with this law

For more information about the law, see below:

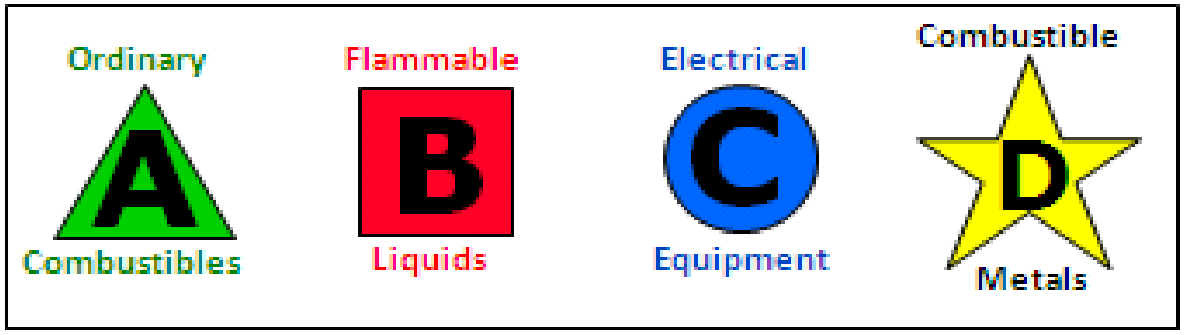
| | Room | Floor |
|---|---|---|
| Principal's Name | | |
| Chemcial Hygiene Officer's Name | | |
| Chemical Hygiene Plan | | |
| Chemical Inventory | | |
| Material Safety Data Sheets | | |
| Laboratory Safety and Health Standard Records | | |
| Personal Protective Equipment (PPE) | | |
| Removal of Hazardous Waste: | | |
| ■ Notify Custodian Engineer | | |

Office of Occupational Safety and Health ▪ 65 Court Street, Room 706 ▪ Brooklyn, NY 11201 ▪ (718) 935-2319

# Extinguisher Classification

Letter classification given an extinguisher to designate the class or classes of fire on which it will be effective.

- **Class A** – ordinary combustibles (wood, cloth, paper)
- **Class B** – flammable liquids, gases, greases
- **Class C** – energized electrical equipment
- **Class D** – combustible metals




WORK shouldn't HURT

## Fire Extinguishers 101:

With so many fire extinguishers to choose from, selecting the proper one for your home can be a daunting task. Everyone should have at least one fire extinguisher at home, but it's just as important to ensure you have the proper type of fire extinguisher. Fire protection experts recommend one for the kitchen, the garage and workshop.

Fire extinguishers are divided into four categories, based on different types of fires. Each fire extinguisher also has a numerical rating that serves as a guide for the amount of fire the extinguisher can handle. The higher the number, the more fire-fighting power. The following is a quick guide to help choose the right type of extinguisher. Also see how to buy a fire extinguisher.

- **Class A**
  extinguishers are for
  ordinary combustible materials such as paper, wood, cardboard, and most plastics. The numerical rating on these types of extinguishers indicates the amount of water it holds and the amount of fire it can extinguish. Geometric symbol (green triangle)

- **Class B** fires involve flammable or combustible liquids such as gasoline, kerosene, grease and oil. The numerical rating for class B extinguishers indicates the approximate number of square feet of fire it can extinguish. Geometric symbol (red square)
- **Class C** fires involve electrical equipment, such as appliances, wiring, circuit breakers and outlets. Never use water to extinguish class C fires - the risk of electrical shock is far too great! Class C extinguishers do not have a numerical rating. The C classification means the extinguishing agent is non-conductive. Geometric symbol (blue circle)
- **Class D** fire extinguishers are commonly found in a chemical laboratory. They are for fires that involve combustible metals, such as magnesium, titanium, potassium and sodium. These types of extinguishers also have no numerical rating, nor are they given a multi-purpose rating - they are designed for class D fires only. Geometric symbol (Yellow Decagon)
- **Class K** fire extinguishers are for fires that involve cooking oils, trans-fats, or fats in cooking appliances and are typically found in restaurant and cafeteria kitchens. Geometric symbol (black hexagon)

Some fires may involve a combination of these classifications. Your fire extinguishers should have ABC ratings on them.

Here are the **most common types of fire extinguishers:**


- **Water extinguishers** or APW extinguishers (air-pressurized water) are suitable for **class A fires only**. Never use a water extinguisher on grease fires, electrical fires or class D fires - the flames will spread and make the fire bigger! Water extinguishers are filled with water and are typically pressurized with air. Again - water extinguishers can be very dangerous in the wrong type of situation. Only fight the fire if you're certain it contains ordinary combustible materials only.
- **Dry chemical** extinguishers come in a variety of types and are suitable for a combination of **class A, B and C fires**. These are filled with foam or powder and pressurized with nitrogen.
    - **BC** - This is the regular type of dry chemical extinguisher. It is filled with sodium bicarbonate or potassium bicarbonate. The BC variety leaves a mildly corrosive residue which must be cleaned immediately to prevent any damage to materials.
    - **ABC** - This is the multipurpose dry chemical extinguisher. The ABC type is filled with monoammonium phosphate, a yellow powder that leaves a sticky residue that may be damaging to electrical appliances such as a computer

Dry chemical extinguishers have an advantage over CO2 extinguishers since they leave a non-flammable substance on the extinguished material, reducing the likelihood of re-ignition.

- **Carbon Dioxide (CO2) extinguishers** are used for **class B and C fires**. CO2 extinguishers contain carbon dioxide, a non-flammable gas, and are highly pressurized. The pressure is so great that it is not uncommon for bits of dry ice to shoot out the nozzle. They don't work very well on class A fires because they may not be able to displace enough oxygen to put the fire out, causing it to re-ignite.

CO2 extinguishers have an advantage over dry chemical extinguishers since they don't leave a harmful residue - a good choice for an electrical fire on a computer or other favorite electronic device such as a stereo or TV.

**It is vital to know what type of extinguisher you are using.**
**Using the wrong type of extinguisher for the wrong type of fire**
**can be life-threatening.**

These are only the common types of fire extinguishers. There are many others to choose from. Base your selection on the classification and the extinguisher's compatibility with the items you wish to protect.

# Safety Equipment

## All laboratories should have the following safety equipment:

- Unobstructed access to an eye wash station with a continuous water supply that can flush both eyes at the same time and that is within reach in 10 seconds;
- Safety shower;
- Chemical Splash Goggles (American National Standards Institute (ANSI) Z 87.1) and a sanitizing goggle cabinet;
- First-aid station which includes a first-aid kit and blood clean-up items;
- Fire blanket;
- Fire extinguishers (as established by building code);
- Acid spill clean-up station;
- Broken glass disposal container;
- Safety and chemical inventory software;
- Chemical and flame-resistant aprons or lab coats; and
- Non-latex gloves.

# Eye Wash & Safety Showers Information:

**What is the flow rate required for the eye wash and safety shower?**
The DOE lab manual (hyperlink; page 16) recommends that the eyewash should provide water (78F – 92F temperature) for 15 minutes of flushing at a rate of 0.4 gallons per minute. Safety shower must provide 20 minutes of tepid water.

**How frequently do we test eye wash and safety shower?**
According to the DOE lab manual (hyperlink; page 16), "Eyewash stations and safety showers must be inspected visually weekly and have an annual maintenance check." The FDNY will require safety showers be tested annually with a record of such maintenance maintained on the premise.

**How do I determine the location of a safety shower?**
Eyewash stations should be at teacher's demo table in all science rooms. Safety showers should be in all acid rooms. When demo or lab rooms are not adjacent to prep room, that lab or demo should have an emergency shower. The shower should be reached within 10 seconds or a distance of 50 to 100 feet (no obstructions). Best practices are to use a stop watch and determine if you have a safety shower located within 10 seconds (from DOE lab manual; page 3). Moreover, FDNY will require a safety shower in rooms where more than 5 gallons of corrosive liquids or flammable liquids are stored, handled, or used (hyperlink; page 32).

# Safe Handling of Alcohol in the Laboratory

Safety home

Each year, accidents involving methanol and other alcohols happen in K–12 schools. and Students have been burned and in some cases scarred for life as a result of such accidents. After the tragic burning of two students in an Ohio school science class in 2006, a news journalist asked the following question of safety consultants, "Should alcohol be banned from K–12 schools?" The consultants replied that students must learn how to handle hazardous chemicals as they will certainly encounter such chemicals in their daily lives.
Alcohol is one of many chemicals that requires special handling in classrooms. It is our job as science teachers to teach students how to minimize risks associated with hazardous chemicals such as methanol. Teachers, before doing a laboratory or demonstration, "What would a reasonable and prudent person do?"

# Procedure for Safe Handling of Alcohol

1. Always practice a laboratory or demonstration before using in the classroom.
2. Wear indirectly vented chemical splash goggles, chemical resistant aprons or lab coats and chemical resistant gloves. Methanol and other alcohols are toxic as well as flammable. Avoid inhalation and skin absorption.
3. Handle alcohols in a chemical fume hood or in a well ventilated (6–10 room exchanges per hour) laboratory. (NFPA 45)
4. Know the location of the A-B-C fire extinguisher, fire blanket, eye wash and shower. These safety items should be in a location where they can be accessed within 10 seconds. Teachers should receive training in the use of all of these items.
5. Know where spill cleanup materials are located in the event of a spill.
6. Do not work alone in the laboratory.
7. Ensure that all ignition sources are removed from the area near the alcohol.
8. **The primary reagent alcohol container should be kept in the chemical storeroom.**
9. Only the minimum quantity of alcohol needed for the experiment should be available to students.
10. Remember the vapors of methanol and other alcohols are flammable and denser than air.
11. Know the chemical and physical properties of all chemicals that are used in the laboratory or demonstrations. Refer to the Material Safety Data Sheets (MSDSs) and share the relevant information with students.
12. Conventional alcohol lamps are unsafe and should not be used by students!
13. When using any flammable in a demonstration, be sure there is a shield between the teacher and the students. The shield only protects students; the teacher is behind the shield - giving a "false sense of security."
14. Keep students away from the demonstration table.
15. Tie back hair, tuck inside a collar/shirt and do not wear loose clothing (e.g., baggy sleeves, etc.)
16. Desk cameras are available today so microchemistry demonstrations are easy to see all over the classroom / laboratory.

# Fume Hood Safety

A laboratory fume hood is a three-sided enclosure with an adjustable front opening. It is designed to capture, contain, and exhaust hazardous fumes generated inside its enclosure. Fume hoods accomplish this by exhausting air through the hood face to the outside of the building. By doing so, fumes are drawn away from the worker's breathing zone. Because exposure to volatile chemicals constitutes one of the top health and safety hazards to laboratory workers, a fume hood operates as a principle safety devise in a laboratory setting.

**Face Velocity**

Several governmental and industry organizations have adopted fume hood safety standards. These standards are designed to measure a fume hood's ability to contain fumes. They are based on a measurement of the speed at which laboratory air enters a fume hood's face opening, i.e. face velocity. The intent of these standards is to designate face velocities that are high enough to contain fumes but not so high as to cause air turbulence between a hood's face and a worker. Below is a list of some standards organizations and the face velocities they require:

**OSHA** (Federal Occupational Safety and Health Administration)

Appendix A 4. (g) Quality. recommends, "...airflow into and within the hood should not be excessively turbulent...; hood face velocity should be adequate (typically 60-100 lfm)..."

**Cal/OSHA** (California Occupational Safety and Health Administration)

California Title 8, 5154.1 requires 100 linear feet per minute with a minimum 70fpm at any one point, except for hoods with carcinogens, which require 150fpm and a minimum of 125fpm.

**National Research Council**

*Prudent Practices in the Laboratory, Handling and Disposal of Chemicals*, recommends face velocities between 80 and 100fpm. 120fpm is recommended for substances with very high toxicity or where outside influences adversely influence hood performance. Face velocities approaching or exceeding 150fpm should not be used.

**NFPA** (National Fire and Protection Agency)

Section 6-4.5 states, "Face velocities of 0.4 m/sec to 0.6 m/sec (80 fpm to 120 fpm) generally provide containment if the hood location requirements and laboratory ventilation criteria of this standard are met."

**ANSI/AIHA** (American National Standards Institute / American Industrial Hygiene Association)

Standard *Z9.5-1992* Section 5.7 requires that, "Each hood shall maintain an average face velocity of 80-120 fpm with no face velocity measurement more than plus or minus 20% of the average."

**S.E.F.A** (Scientific Equipment & Furniture Association)

*SEFA 1.2-1996* Section 5.2, "Government codes, rules and regulations may require specific face velocities. A fume hood face velocity of 100 fpm is considered acceptable in standard practice. In certain situations face velocity of up to 125 fpm or as low as 75 fpm may be acceptable to meet required capture velocity of the fume hood."

**N.I.H.** (National Institutes of Health)

*National Institutes of Health Fume Hood Containment Testing* states, "Face velocity measurements shall meet an air velocity profile of 100 fpm plus or minus 10 fpm with the sash fully open."

**NIOSH** (National Institute for Occupational Safety and Health)

NIOSH recommends face velocities of 100 to 150 fpm

Knutson, G. *Fume Hood 2000, Laboratory Hood Testing and Evaluation*. Presentation given at the Fume Hoods 2000 Seminar. April 21, 1999

**ACGIH** (American Conference of Governmental Hygienists)

I*ndustrial Ventilation A Manual of Recommended Practice* recommends 80 - 100 fpm face velocity with a full open sash depending on quality of supply air distribution and uniformity of face velocity.

**Fume Hood Testing**

Face velocity has been accepted as an adequate measure of a fume hood's performance for many decades. It has become such an established method, that it is the only performance standard established by the various standards organizations listed above. It is also the only performance test that is likely to be performed after a fume hood is installed. However, many current studies have argued for more thorough testing of fume hood containment capabilities.

ASHRAE, The American Society of Heating, Refrigerating, and Air-Conditioning Engineers, has created the *ASHRAE 110-1995 Method of Testing Performance of Laboratory Fume Hoods*, a protocol for fume hood testing. This protocol does not specify a performance level fume hoods should meet; It simply provides a more thorough protocol for fume hood performance testing than has historically existed. This protocol allows occupational safety organizations, such as those listed above, to adopt new performance standards to this more thorough method of testing.

The ASHRAE 110 is a three part test that includes measurements of face velocity, air-flow visualization, and tracer gas containment. This exhaustive test protocol goes beyond face velocity measurement to test the ability of a fume hood to contain and exhaust fumes. Air flow visualization requires the generation of smoke streams at designated points within a fume hood. It provides a visual understanding of the air flow currents that exist within the hood. The tracer gas containment test releases a large volume of gas at a prescribed location in a hood. A mannequin is positioned in front of the hood face with a monitoring device affixed in its breathing zone. The monitoring device tests for the presence of the tracer gas outside the hood.

The ASHRAE 110 offers a direct method of measuring a fume hood's ability to contain the fumes produced within its enclosure.

# Safety Tips for Lab Refrigerators and Lab Freezers

March 29th, 2011

A flammable refrigerator would have avoided this damage caused by a thermostat spark

Improperly specified or used lab refrigerators and lab freezers pose a significant threat to personnel and equipment when volatile vapors or gases are in the laboratory environment or are given off by products being handled and stored. There are many recorded incidents of explosions, fire, and severe property damage due to vapors and gases being ignited within the storage units or in the lab itself that are caused by incorrectly specified or improperly used laboratory refrigerators and freezers.

## What You Need to Know

Lab refrigerators and freezers used to store volatile substances or used in rooms where such substances are in the air must be specially designed to isolate any source of ignition from these substances.

Designed to strict specifications, flammable storage refrigerators and freezers must be used when volatile products are being stored. **Using sealed non-breakable containers is not an option.** Explosion-proof units must be specified when vapors in the laboratory could be ignited by a stray spark. Conventional household or standard lab refrigerators and freezers cannot be safely modified to avoid a disaster.

Sources that can cause internal ignition of vapors include lighting, timer housings for defrosters, thermostats and compressors. A spark-initiated explosion can blast off the door, scattering refrigerator or freezer parts and contents across the room with possibly fatal consequences to individuals unfortunate enough to be in the way. That is why these units are constructed to isolate the contents from any source of internal ignition.

More costly explosion-proof units have stricter design requirements that separate internal and external environments. Unlike the flammable units that can be plugged into a wall outlet, explosion-proof units are hard wired into the building's electrical grid.

## The Take-Away

"Saving money" is a poor excuse when considering the hundreds if not thousands of dollars in cost and potential injury that can occur when improper units are used.

Deciding between explosion proof and flammable storage is easy. If the explosive vapors are on the outside of the refrigerator choose explosion proof. If they are only on the inside of the refrigerator choose flammable storage.


United Federation of Teachers

A Union of Professionals