CHEMICAL SAFETY MANUAL FOR PENNSYLVANIA SCHOOLS

Help Keep Your School Safe

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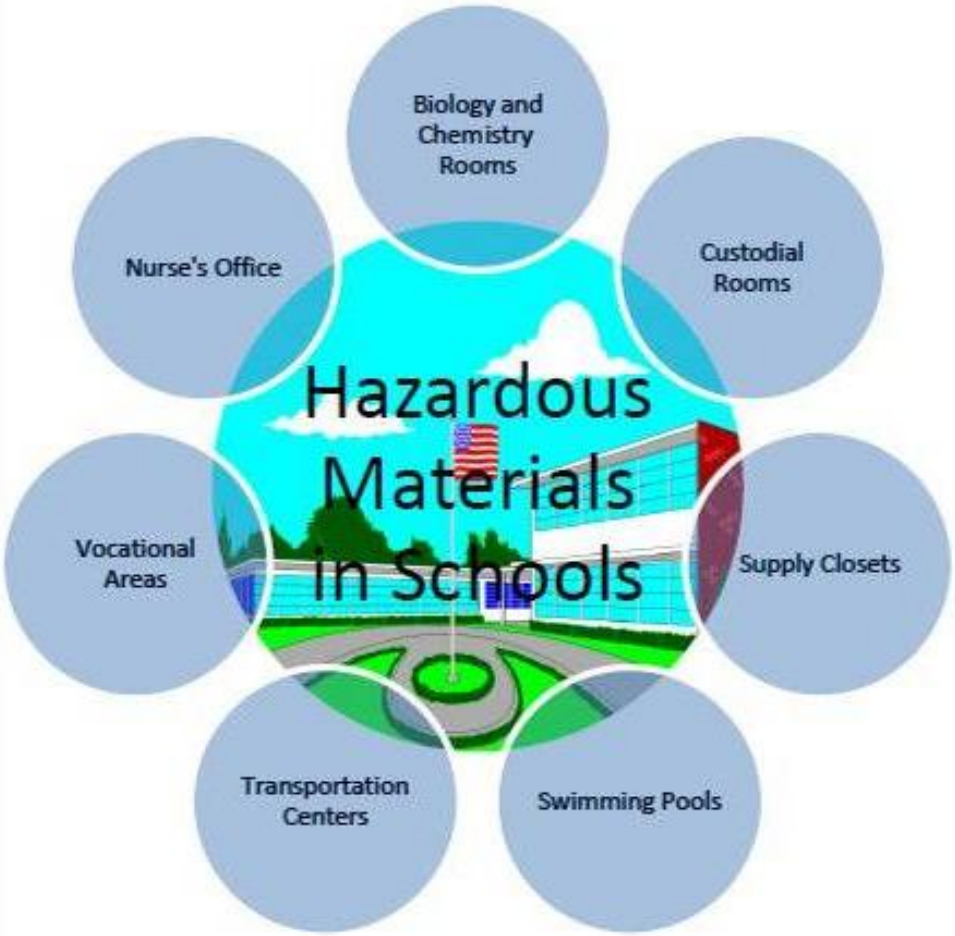
1.0 INTRODUCTION

Pennsylvania's elementary schools, middle schools and high schools are home to a variety of chemicals. These materials can be found in chemistry and biology labs, maintenance facilities, custodial closets, nurse's offices, swimming pools, vocational shops, and other areas. When they are mismanaged, these chemicals can put students and school personnel at risk from spills, fires, and other accidental exposures. Chemical accidents disrupt school schedules and can cost thousands of dollars to repair.

The Environmental Protection Agency (USEPA) Schools Chemical Cleanout Campaign (SC3) aims to ensure that all schools are free from hazards associated with mismanaged chemicals. The Pennsylvania Department of Environmental Protection (PADEP) created this manual to give K-12 schools information and tools to responsibly manage chemicals. Additional information and resources can be found on the USEPA's Schools Chemical Cleanout Campaign web page at http://www.epa.gov/epawaste/partnerships/sc3/index.htm.

Additionally, the Pennsylvania Worker and Community Right to Know Act of 1984 requires public sector employers (including school districts) to take various actions, including completing a hazardous substance survey, maintaining a file of material safety data sheets (MSDSs), labeling all containers of hazardous substances or hazardous mixtures, and providing information on the Act, employee rights and the inventory to their employees. This manual will help school districts meet the requirements of that Act.



1.1 Hazardous Materials in Schools

Many of the chemicals that may be found in schools have hazardous properties. These may be cleaners for janitorial services, fuel for landscaping equipment, paints and thinners in art classrooms, mercury in medical equipment, reagent chemicals and preservatives in laboratories, or even air freshener spray in a classroom. All of these could be hazardous if mismanaged or used improperly.

Adding to the potential hazard, the chemicals may not be stored safely. They may be stored with incompatible chemicals, in glass containers on high shelves, or stored in a location where the container or label can deteriorate to the point that they cannot be easily identified.

DAMAGED CONTAINERS WITHOUT LABELS

Uncertainty about proper disposal procedures may lead to unneeded chemicals being kept for years, allowing them to deteriorate, become contaminated or become unstable.

The information available in this manual will help you develop a successful chemical management program, identify, and safely dispose of unneeded, unsafe, and unidentified chemicals in your school.

1.2 Chemical Management Plans

Chemical management plans are the cornerstone of any school's ability to regulate the materials and control the use of chemicals by employees and students within their buildings. This manual will help provide a method to get the chemical management plan in-place. Once the management plans are developed, the manual will help the schools identify and eliminate unneeded, unsafe, and unidentified chemicals. More details will be provided later in this manual.

1.3 Responsibilities of Administrators, Coordinators, and Teachers

Administrators

Administrators (e.g., school principals, superintendents, facilities and transportation directors) are essential to the successful implementation of a chemical management program. Administrators play an active role in addressing chemical mismanagement issues by appointing an individual (staff member or consultant) to serve as the chemical coordinator and supporting the overall program.

Chemical Coordinator

Chemical Coordinators are the key players to manage the issues of the chemical management program. They are the chief organizer and address the chemical mismanagement issues by delegating the necessary steps to implement a program. Example duties and responsibilities of this position include:

- Act as liaison between administration, teachers, the school district, and community partners;

- Work with community partners (such as the Fire Departments, Local Emergency Planning Commission (LEPCs), or Boards of Health) to help develop and implement policies;

- Implement policies regarding the purchase, inventory, use, management, storage, and disposal of chemicals in schools.

- Budget for a chemical inventory of all areas of the school;

- Arrange for appropriate expertise to conduct a chemical inventory on-site and remove unwanted and accumulated chemicals;

- Budget for regular removal of on-site waste chemicals generated from science labs, art classrooms, nurse's office, vocational shops, facility operations and maintenance, and other areas that use chemicals

- Evaluating all chemicals, including donations, coming into the school for risk, storage and disposal requirements, need, and existing stocks before accepting;

- Provide chemical management training for teachers and staff:

  - Require annual chemical awareness and management training for all personnel throughout the school district who are involved in purchasing, use, and management of chemicals.

  - Ensure all chemical safety equipment is working and personnel and students, where appropriate, are trained in its use.

- Incorporate chemical management oversight into full facility assessments using tools, such as, the Healthy School Environments Assessment Tool. The link is provided below.

  http://www.epa.gov/schools/healthyseat/index.html

- Consider contracting with vendors who provide Chemical and Resource Management Services (CRMS). CRMS has two components:

  - Chemical Management Services (CMS) - typically involves a long-term contract for provision of chemicals and assistance with associated management services (e.g. chemical tracking, regulatory compliance).

  - Resource Management Services (RMS) - providers haul waste and recycled goods, and also help adjust upstream activities to reduce the amount of material entering the waste stream.

Teachers

Teachers can reduce the environmental and health hazards in their school by ensuring that classroom chemicals are managed in a responsible manner and working collaboratively to help implement a chemical management program by:

- Learning about chemical hazards, safety practices, and requirements for handling chemicals;
- Obtaining and maintaining Material Safety Data Sheets;
- Working with chemical management professionals who have been contracted by your school to identify and remove chemical hazards;
- Educating students about the proper handling of chemicals and safety procedures;
- Ensuring that your lab or classroom is equipped to handle potential mishaps associated with chemicals;
- Keeping chemicals in a locked, restricted area, away from students and potential vandals;
- Taking into account the toxicity and quantity of chemicals used to clean and maintain classrooms;
- Centralizing your classroom's chemical inventory;
- Building awareness of the issue with others in the school system;
- Obtaining support at all levels within the school, from the principal to custodian, to address chemical use and management; and
- Working cooperatively with district wide contacts (superintendent, facility manager, etc.).

Teachers and other staff should not bring any chemicals from home without the approval of their school administration or chemical coordinator.

2.0 Chemical Management Plans

The best method for handling chemicals is a written chemical management plan that has established, written procedures and specific school information. It is a general plan for complying with best management practices regarding storage, use and disposal of chemicals. However, it also contains specific information on emergency procedures, local contacts, and site specific information. The chemical management plan should be reviewed annually and updated to reflect current school and contact information. The plan is intended to allow you to track incoming chemicals "from cradle to grave." Meaning, you can manage them from the time you receive them until the time you either use them up or discard the unused, unneeded portion.

The first step of the plan should be to designate a chemical coordinator. The chemical coordinator will be responsible for conducting and maintaining an inventory of all chemicals, coordinating the proper disposal of unwanted chemicals, purchasing chemicals (or authorizing the purchase) when needed, and ordering appropriate safety supplies related to safe chemical handling.

An inventory of all chemicals located on-site should be conducted under the direction of the chemical coordinator. This inventory should include the identity and quantity of each chemical, and an evaluation of the condition of the chemical container and of the chemical itself (crystallized liquid, both liquid and solid phase present, evaporated solvent, discoloration, etc.), as well as the specific location, classification, and purpose of the chemical.

The chemical coordinator will then determine what chemicals are needed and will be used, and what are not needed and can be properly disposed. Most chemicals will probably need to be disposed as hazardous waste, which will require arranging for a licensed hazardous waste company to safely package and transport the waste to the disposal site.

The chemical coordinator should ensure that a copy of the Material Safety Data Sheet (MSDS) for each remaining chemical is present at the site and available for review. Electronic copies of the MSDS are acceptable as long as they are readily accessible. Additional information on MSDS and other sources of chemical hazard information is available in **Appendix A**.

The chemical coordinator should evaluate the storage locations and storage systems (including flammables storage cabinets, shelving, and the method of chemical organization). It is important to ensure that chemicals are stored properly and handled safely.

The chemical coordinator should oversee development of a spill response plan based on the remaining chemical inventory, and obtain and maintain spill response equipment and personal protective equipment (PPE). The chemical coordinator, in cooperation with affected staff, should evaluate and implement strategies for reducing the use of hazardous chemicals in all areas of the school.

Additionally, the Occupational Safety and Health Administration (OSHA) requires that all laboratories implement a written Chemical Hygiene Plan (CHP). While OSHA does not currently cover public schools, development of a CHP may be required by your insurance carrier, and it is recommended as good safety practice. Private schools are covered by OSHA, and are required to implement a CHP.

Topics that should be addressed in the laboratory's chemical hygiene plan include rules and procedures regarding the following:

1. Chemical procurement, distribution and storage.
2. Housekeeping, maintenance, and inspections of the stockroom and laboratories.
3. Personal protective apparel and equipment for teachers and staff.
4. Warning signs and container labels to identify hazards.
5. Spill response procedures.
6. Waste disposal.
7. Training of staff in the plan.

OSHA requires that a Chemical Hygiene Officer be appointed to implement the plan. The Chemical Hygiene Officer may be the chemical coordinator, a staff member from within the school or school district, or a person or company under contract.

The school's chemical management plan can be used to fulfill the OSHA requirement for a CHP if it adequately addresses all of the necessary topics. A separate document would not be necessary. This would be more convenient and save time and money for the school districts.

3.0 CONDUCTING A CHEMICAL INVENTORY

3.1 Purpose of the Inventory

The chemical management plan starts with an inventory to identify all chemicals that are present in the facility. This detailed study will enable the chemical coordinator to evaluate the chemicals and determine which are excess or unsafe, and need to be removed from the school. Having a complete chemical inventory will also enable the chemical coordinator to avoid purchasing chemicals that are already present in the school.

3.2 Safety Guidelines for Conducting a Chemical Inventory

- Wear appropriate personal protective equipment (PPE) when conducting the inventory. This should include closed-toe shoes, safety glasses and latex or nitrile exam gloves at a minimum. Additionally, a lab apron, splash goggles and face shield are recommended.

- The chemical inventory should only be performed by personnel who have adequate knowledge and experience with chemical safety and use. Students should not be permitted to perform the chemical inventory.

TYPICAL CHEMICAL STORAGE

- Chemicals found in middle and high schools pose risks to staff and students because of their hazardous characteristics (flammability, corrosivity, reactivity or toxicity) and because their containers and contents may have deteriorated over time. Chemicals that have become shock-sensitive or containers that have become pressurized or damaged can cause serious injuries.

- Don't move bulging, leaking, or deteriorated containers unless you are sure it is safe. Don't move any container that contains crystals in a liquid or both liquid and solid phase chemical. These are potentially explosive and should be left alone.

- Don't attempt to open any unidentified solvent bottles, or bottles that contain any of the peroxide-forming chemicals listed in **Appendix B**. Make a note of any such hazardous conditions on the inventory form.

- During the inventory, you will likely have to move and turn some chemical containers to be able to read the label. A flashlight and small mirror should be on hand to enable you to read labels on the backs of containers that are not safe to move, and to see items in the back of storage cabinets.

- Always have a telephone or other means of communication handy to summon help in the event of a spill or emergency. Develop a written spill response plan that includes a list of emergency phone numbers. Note the locations of the nearest emergency eyewash and shower before starting the inventory in each area.

3.3 Inventory Procedure

Ensure that you allow sufficient time to complete the inventory. All potential chemical storage areas will need to be investigated, including stockrooms, storerooms, custodial closets, maintenance sheds, basement and attic storage rooms, and garages. The inventory may take more than a few days to complete.

The inventory should ideally be conducted by a team of two people. One team member will systematically go through the storage area and read out the name and quantity of each chemical while the other team member records the information on the inventory form.

CHEMICAL INVENTORY IN PROCESS

Collect adequate information on each chemical so the chemical coordinator can determine whether the material is excess or needed. The minimum information collected should include location, chemical name, container size, number of containers, condition of the containers, use of material, and other information from the label, such as purchase date or expiration date.

3.4 Sample Chemical Inventory Forms

While individual-styled chemical forms may be desired by a school district, it is important that specific information is collected. A sample chemical inventory form is shown below. This chemical inventory form is available electronically.

http://www.portal.state.pa.us/portal/server.pt?open=514&objID=589603&mode=2

This form includes space for additional information if the chemical coordinator wishes to populate it. The Pennsylvania Hazardous Substance Survey Form is located in **Appendix C**. Your chemical inventory form can be designed to collect the information that your chemical coordinator decides is needed.

Chemical Substances Inventory of Identifiable Chemicals

Chemical Name	Number of Containers	Container Size	Container Type (e.g., plastic, glass)	Condition of Container (e.g., corroded, has crystals around the cap, bulging, degraded top)	Chemical Uses? (e.g., chemistry lab, art room, school maintenance)	Needed or in Surplus Quantities	MSDS (Yes or No)	CAS Number	Risk Levels	Toxicity Rating	Flammability Rating	Reactivity Rating	Special Hazard Rating	Hazards Rating	Expiration Date (mm-dd-yy)

4.0 HIGH RISK CHEMICALS

4.1 Excessive Risk Chemicals: Risk Exceeds Educational Utility

Some chemicals have such a high risk associated with them because of their hazardous characteristics that they should not be used in schools for any purpose. The list of chemicals in **Appendix D** was compiled from various sources including NIOSH, EPA, and other State Programs, and includes those chemicals that most experts believe present an unacceptable likelihood of causing problems relative to their educational usefulness.

MERCURY BAROMETERS

Teachers who want to use any of these chemicals for a unique science experiment should either purchase the smallest amount possible, or a dilute solution. It is preferable to present a similar experiment that does not require the use of a high risk chemical. Students should not be permitted to handle or perform experiments using any of the high risk chemicals.

The following sections present some basic information on high-risk chemicals that may be found in schools or laboratories.

4.2 Mercury

Elemental mercury is a heavy, silvery, odorless liquid metal. It is also volatile, its vapor being colorless and very toxic. Spills of mercury are especially dangerous for children due to the potential damage to their developing central nervous system.

Mercury-containing equipment can be found in various areas of a school, as shown by the examples in the table below.

Science Labs	Maintenance	Nurse's Office
Elemental Mercury	Fluorescent Lamps	Thermometers
Mercury Thermometers	Mercury Thermostats	Blood Pressure Devices
Mercury Barometers	Mercury Vapor Lamps	
Mercury Compounds	Mercury Light Switches	**Home Economics**
• Mercury Oxide	Mercury Switches & Relays	Cooking Thermometers
• Mercury Chloride		
• Mercury Nitrate	**Art Rooms**	**Other**
• Mercury Sulfate	Paint (Vermilion)	Mercury Batteries

4.3 Peroxidizable Solvents and Metals

While we generally think of the hazards associated with solvents as being flammability and toxicity, some can also form unstable peroxide compounds as they age and are exposed to light and air. See the lists of peroxide-forming chemicals in **Appendix B**. These peroxide compounds can be explosive, and often form in the threads of the cap after opening. Accidentally bumping the container or attempting to unscrew the cap can set them off, causing both serious injuries and property damage. Often, an inhibitor such as BHT (butylated hydroxytoluene, a common anti-oxidant) is added to the chemical to prevent the formation of peroxides.

Steps you can take to limit the formation of peroxides in uninhibited peroxide-forming solvents include tracking the use of the chemical. Record the date it is first opened, and mark it on the container or on a hang tag on the neck of the bottle. Use the contents within six months (three months for the severe peroxide forming chemicals listed in **Appendix B**, and discard any unused material after that time. Never allow peroxide-forming solvents to contact any metal objects. Contamination by metals can lead to explosive decomposition. Store the material at the lowest possible temperature but do not refrigerate or freeze it. Keep the material in opaque containers away from light sources. Additionally, wipe down the threads of the bottle after pouring, and purge the container head space with nitrogen gas before closing it.

Avoid evaporation or distillation of these solvents. If you must heat or evaporate a peroxide-forming solvent, test it for the presence of peroxides before using it. A simple qualitative test can be performed on peroxide forming compounds to test for peroxide content. Test strips have also been developed that will directly test for the presence of peroxides in simple ethers, such as diethyl ether, tetrahydrofuran, and 1,4-dioxane.

Diethyl ether (ethyl ether, diethyl oxide, ethoxyethane) was found stored in two Pennsylvania schools during the SC3 pilot project, and had to be removed by bomb disposal experts. This chemical was frequently used in biology and chemistry labs. If you must have ethyl ether in your lab, it is extremely important to handle it properly, as described above.

The alkali metals, lithium, sodium, potassium, rubidium, cesium, and francium also form unstable peroxides when exposed to air. They are extremely water reactive and must be stored under oil or kerosene to prevent contact with water. Even when stored correctly, over time enough air diffuses through the oil to allow peroxides, which are yellowish in color, to form. Alkali metals must be examined frequently to ensure that the oil or kerosene has not spilled, leaked or evaporated, and that peroxides have not developed.

ALKALI METALS

4.4 Oxidizers

An oxidizer is a chemical that acts like oxygen in a chemical reaction, by accepting an electron. Common examples of the oxidation reaction include rust and fire. Oxidizers may actually contain oxygen, or they may contain other compounds that perform the same chemical function. This requirement is met by other chemicals in the class of compounds known as the halogens, and by materials that can act as halogenating agents. Examples of this include fluorine and chlorine in the gaseous state, and bromine in the liquid state.
Common oxidizing chemical groups include peroxides, nitrates, nitrites, perchlorates, chlorates, chlorites, hypochlorites, dichromates, permanganates, and persulfates.

Oxidizer Safety Precautions

- Oxidizers should not be stored with flammable or combustible materials,
- Oxidizers should not be stored on wooden shelves.
- Nitric acid and perchloric acid should be stored separately from other acids.
- Perchloric acid needs to be used in a completely separate, specially-constructed laboratory hood equipped with water wash-down capabilities.

4.5 Highly Reactive Chemicals

These chemicals are potentially explosive, and contain both fuel and oxidizer in the same chemical molecule. Chemical names that include in part names such per-, peroxy, azo- and cetylide should cause you to consider the presence of fragile bonds of peroxides, azides and acetylides. Diazo, nitroso, haloamine, and ozonide compounds are also sensitive to shock and heat. Another warning sign is an organic molecule with a large amount of bonded oxygen which could lead to a large volume release of gas and energy on decomposition.

Examples of Highly Reactive Materials

Highly reactive materials are solids, liquids or gaseous materials that exhibit any of the following properties:

- The material is normally unstable and readily undergoes violent change without detonating. Examples are materials that are capable of polymerization reactions, such as polyvinyl benzene.

- The material reacts violently or explosively with water (water reactive). Examples include the alkali metals (lithium, potassium, sodium), magnesium, phosphorous, aluminum chloride, acetyl chloride, and many hydrides.

- The material is pyrophoric, that is, it self-ignites in the presence of air. Examples include cesium, diethylzinc, nickel carbonyl, potassium, silane, silicon tetrachloride, white and yellow phosphorous, sodium, tetraethyl lead and triethylaluminum, and many organometallic compounds.

- The material, when contaminated or decomposed, becomes unstable and is readily capable of undergoing violent change and/or detonating. Examples include peroxide forming materials and reactions involving explosive combinations of incompatible materials.

Additional specific examples include picric acid, methyl vinyl ether, cyclonite, lead azide, lead styphnate, acrylaldehyde, disodium acetylide, methyl methacrylate, vinyl chloride, tetrafluroethylene, and chlorotrifluoroethylene.
Picric acid is commonly used in biological laboratories. If allowed to evaporate dry, it becomes an extremely shock-sensitive explosive. It also can form shock-sensitive salts on contact with metal.

For shipping and storage, these chemicals may be diluted to reduce their hazard. They are often diluted with water, but sometimes with another chemical such as phenol, hydroquinone, or triethanolamine. They must be carefully monitored during storage to maintain a safe dilution level. Never open or move a container of one of these chemicals unless you are sure of its dilution level.

4.6 Highly Toxic Chemicals

All chemicals are toxic at some concentration or dosage, even plain water. Some chemicals are toxic or even fatal at low concentrations or doses. Acute toxicity is generally associated with a short duration exposure or dosage, often at a high concentration, but some materials may be so toxic that a small amount, less than a teaspoon, can cause an extreme reaction. Chronic toxicity refers to systematic damage that is done after repeated exposures to low concentrations over a long period of time. Chronic toxins are often carcinogens.

A few examples of highly toxic chemicals that may be found in the laboratory include bromine, cyanide compounds, hydrogen sulfide, nitrogen dioxide, mercury, lead, vinyl chloride, benzene, carbon disulfide, carbon tetrachloride, cadmium compounds, arsenic compounds, and hydrofluoric acid.

Toxic Chemicals

Everyone working with any highly toxic chemical that is to be kept in use must be very familiar with its characteristics, techniques to prevent exposure and first aid procedures in the event of an exposure. If cyanide salts are present, a first aid kit specific for cyanide poisoning must be on site as well, as cyanide poisoning is almost immediately fatal.

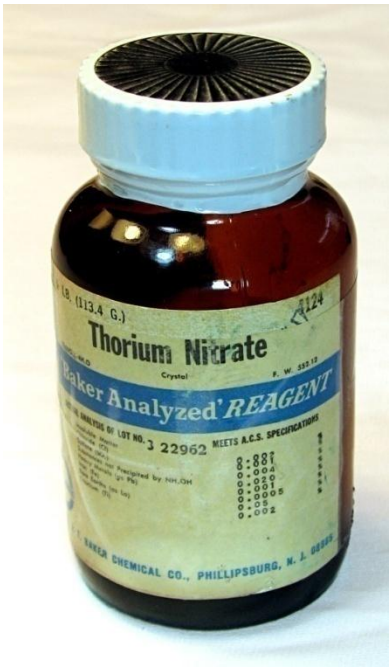
Many highly toxic chemicals are “P-listed” under hazardous waste regulations. Other, less toxic but still dangerous chemicals are “U-listed” hazardous wastes. A facility deciding to discard (generate as waste) any of the P-listed chemicals in amounts greater than one kilogram in a calendar month will be subject to full regulation as a hazardous waste generator. This high level of regulation includes but is not limited to special

notification to the Pennsylvania Department of Environmental Protection Agency (PA DEP), biennial hazardous waste reporting and implementation of special emergency management procedures and training. The PA DEP Division of Hazardous Waste Management should be contacted at (717) 787-6239 for more information regarding hazardous waste requirements.

4.7 Chemicals Regulated by the Drug Enforcement Administration

"Controlled substances" are narcotics and other chemicals with the potential of being abused, mainly for recreation or performance enhancement. Controlled substances are strictly regulated by the Drug Enforcement Administration (DEA). Compliance with these regulations is very difficult, and it is easy to get into trouble. Some examples of controlled substances that have been found in schools are chloral hydrate, testosterone, phenobarbital, morphine and amyl nitrite (an essential component of cyanide-poisoning first aid kits).

4.8 Radioactive Materials



RADIOACTIVE CHEMICAL

Radioactive materials are unstable isotopes of elements which emit alpha, beta, or gamma radiation when they decay. Radioactive materials are regulated by the PADEP Bureau of Radiation Protection. These regulations require meticulous record keeping, licensing, and monitoring. Most schools districts are not properly addressing the regulatory issues dealing with radioactive chemicals or materials. While other school districts may not want or be able to handle the duties of documenting and storing radioactive materials. School districts need to decide how to deal with the storage of radioactive materials and/or their disposal. Disposal of radioactive materials also can be difficult and very expensive.

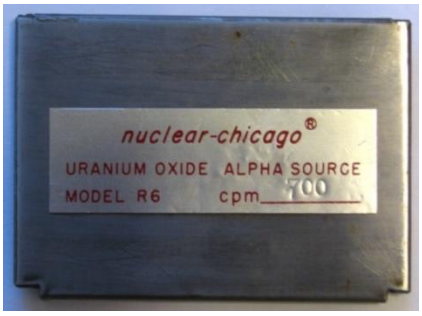
Radioactive materials that might be found or used in a school include: naturally-occurring mineral samples, thoriated tungsten welding electrodes, luminescent radium clock dial markings (on very old clocks), ionization smoke detectors, self-luminous exit signs, uranium glass optical filters, older pieces of vaseline glass or glazed pottery, lantern gas mantles, and other manufactured products. In the science lab, thorium nitrate, uranium tetrachloride, and other radioactive powders also may be present. While possessing these materials within the schools would not require a specific license, all of these items can emit low-level radiation and require special attention.

If radioactive materials are present or suspected to be present in your schools. Radiation safety should be included in the overall chemical management and safety program. Radiation safety is guided by the "ALARA" principle, which keeps exposures "As Low As Reasonably Achievable". Every radiation source in a school could add to the overall exposure of the school's population.

Most authorities agree that any radiation source which requires a license (specific or general license) to own or use does not have a place in Pennsylvania schools, especially grades K through 12. In the science lab, any non-sealed sources or radioactive powders should be discarded due to the potential for accidental inhalation of the dust during handling and radiation affects.

Additionally, the use of thoriated tungsten electrodes in welding operations, such as tungsten inert gas (TIG) welding, should be discouraged in school vocational programs. Use of this specific equipment may propose a problem for many schools. Grinding the electrodes tips to a point suitable for welding generates thorium-containing dust (typically 2% thorium) that should be controlled, contained, and properly disposed. Student welders just developing their skills may not be able to control the arc gap adequately to maintain the tip point; thus, necessitating frequent re-grinding of the electrode tip. A practical suggestion would be to substitute plain tungsten electrodes or lanthanated tungsten for the thoriated tungsten. School officials need to research and document the equipment use, proper safe practices, and disposal methods of the welding operations to avoid any potential problems or issues.

The educational value of radioactive mineral samples used in science or chemistry programs should be evaluated on a case-by-case basis. Schools may still want to include the use of these materials. While many factors may help decide if radioactive materials will be present in individual schools, it is very important that the condition of the samples, storage cases (whether they are coated or encased in plastic) and storage conditions be factored into the decision of whether to keep or discard them.



CALIBRATION SOURCE

Self-luminous exit signs typically contain tritium, a weak beta radiation source. These signs are distributed to schools under a general license, and when in use, provide valuable exit path marking relative to any radiation exposure risk. However, they are regulated and must be properly disposed when they are replaced or broken. They should not be put into the general trash or sent to a general landfill. They must either be returned to the distributor or manufacturer, or sent to a licensed radioactive waste broker or low-level waste disposal facility for proper decommissioning and disposal. Additional information is available from the PA DEP.

http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-81209/2910-FS-DEP4061.pdf

4.9 Formaldehyde

Formaldehyde can be present in some preservatives found in most schools and could be a concern for exposure. Formaldehyde gas, chemical formula HCHO, is a known carcinogen, respiratory irritant, and a sensitizer. Formaldehyde exposure is typically through inhalation, but it can also be absorbed through the skin, as can the methyl alcohol portion of the solution. Biology laboratory specimens and tissue samples were often preserved with formalin (made with formaldehyde gas), giving them a characteristic odor. Formalin is a solution of typically 37% formaldehyde gas in water with 10% to 15% methyl alcohol added to prevent polymerization. Great care must be taken to minimize exposure to formaldehyde when handling specimens preserved with formalin. School officials should address specific handling, use, and storage procedures associated with this chemical.

5.0 MANAGING CHEMICALS IN SCHOOLS

Chemical management encompasses chemical procurement, storage, distribution, and use. The chemical coordinator should develop a written procedure for each subject. Chemical management is a district-wide effort, and not just the responsibility of the science teachers.

The following table shows some of the locations where chemicals and hazardous materials may be found.

School Department	Hazardous Materials
Science Rooms and Laboratories	Flammable liquids (acetone) Oxidizers (bleach) Reactives (picric acid) Toxics (cyanides, phenol)
Technology Education (Graphic Arts, Printing)	Photographic chemicals Dyes Petroleum-based inks Cleaning products
Industrial Arts (Woodworking, Auto Repair and Metal Shops)	Degreasing solvents Petroleum solvents, stains, and paints Cleaning products Welding gases Used oils
Custodial and Maintenance	Cleaning products Petroleum solvents Paints Pesticides Aerosols
Art	Petroleum solvents Glues and adhesives Oil-based paints Glazes with toxic metals Pigments with toxic metals Acids for etching

5.1 General Strategies

Purchase the least hazardous chemical that will do the job. “Green” and low volatile organic compound (VOC) cleaners and paints are preferable from both a hazardous material management and an indoor air quality (IAQ) standpoint.

Do not accept samples or donated chemicals or products unless they are needed for a specific purpose or project.

Maintain an MSDS for each chemical or product used or present in the school. These documents need to be readily accessible to both personnel who use the products and to emergency responders. A copy of all MSDSs should be kept in the chemical coordinator's office. An MSDS for each chemical in a given storage area should be kept near, but not inside, that storage area.

Under the Pennsylvania Worker and Community Right to Know Act of 1984, all staff who work with or have a potential for exposure to hazardous chemicals must be provided annual training and information on the locations, proper use, hazards, protective equipment, and proper disposal required for each. Additional training and information must be provided whenever new products are added to the inventory. See **Appendix C** for additional requirements of the Act. The following link will provide more information.

http://www.portal.state.pa.us/portal/server.pt?open=514&objID=553055&mode=2

Try to minimize the total quantity of each hazardous material in storage to just what will be actually needed before the next order.

Minimize the number of chemical storage locations. Each department should have a storage location that is accessible only by them.

When a chemical or product is received, mark the date on the package or case. When an individual container is opened, mark this date on it, along with the expiration date, for products that have a limited shelf life after opening.

Perform an annual inventory and inspection, looking for signs of leaking or bulging containers, damaged labels, deteriorated chemicals and containers, and products past their expiration date. Immediately replace damaged labels, and remove expired products.

Prepare a written spill response plan that covers each type of chemical or product used or stored at the school. It should cover responding to both large and small quantity spills, in the locations where they are likely to be spilled (such as mercury spill in the laboratory, gasoline spill in the maintenance shed, or drain opener spill in the restroom). It should also include notification and waste disposal requirements for the spills, and recommended personal protective equipment.

Obtain chemical spill kits for each storage area. Each kit should contain supplies that are appropriate to the chemicals stored in the area. Spill management is more thoroughly discussed in Chapter 9.

5.2 Standards for Chemical Storage Rooms

Chemical storage areas should provide a safe, secure, and compatible home to your chemicals and products until they are used. The storage area should be able to protect the product from damage, and also protect the building and personnel from the chemical hazard.

- Chemicals and products should not be stored directly on the floor. Place larger containers, such as drums, on spill-control pallets.

- Chemicals should be stored at an appropriate temperature and humidity level. Do not store chemicals in direct sunlight or near a heat source. Do not store chemicals in locations where they may get wet, it could degrade the container or label, and the chemical might be water-reactive.

- The storage room should have an adequate ventilation system that is separate from the general ventilation system. Ventilation systems on storage rooms with flammable products should be able to maintain the atmosphere at less than 25% of the lower flammable limit.

- Volatile chemicals should be stored in well-ventilated areas that are exhausted to the outside of the building to maintain indoor air quality.

- An inventory of the chemicals present should be maintained in each room where chemicals are stored. MSDSs for the chemicals should be kept nearby.

- Hazardous material storage cabinets should be anchored to the wall. Storage shelves should have a lip at the edge to reduce the risk of chemicals accidentally sliding off. Storage shelves should be strong enough to support their anticipated load.

- Doors on storage cabinets should be closed and latched (and locked when not in use).

- Class ABC fire extinguishers should be kept near locations where chemicals are stored or used. Employees should receive annual training in their operation and limitations. If flammable metals are present, a Class D fire extinguisher should also be present.

5.3 Chemical Storage Systems

A variety of different chemicals with different hazards may be present in different departments in a given school. Improper storage of these chemicals may lead to an increased risk of reaction in the event of container failure or spillage. Proper storage of chemicals will help to reduce this risk.

FLAMMABLE STORAGE CABINET

- Do not store chemicals randomly or in alphabetical order. This increases the risk of incompatible chemicals coming into contact, especially in the event of a fire or other emergency event.

- Do not store chemicals in a laboratory hood, on bench tops or under sinks. They interfere with the airflow in the hood, are more easily knocked over and could potentially spill into a drain.

- Do not store flammable chemicals in a regular refrigerator. This could result in an explosion and fire. If flammables must be refrigerated, store them in a designated explosion-proof or flammable material refrigerator. Do not store food in a designated chemical refrigerator.

- Flammable and volatile chemicals should always be stored tightly capped to keep their vapors from interacting and to reduce the potential for human exposure. Always store flammable materials in a flammable storage cabinet, well away from oxidizers.

- Do not store combustible materials inside or on top of flammable material storage cabinets.

- Store corrosive materials in corrosion-resistant containers and cabinets. Store acids and bases separately. Store oxidizing acids, such as nitric acid and perchloric acid separate from other acids. See Section 5.4 for additional information on chemical segregation.

- Liquids, corrosive chemicals, and glass containers should not be stored on shelves above eye level. It is preferred that no chemicals be stored above eye level.

- Store heavier containers at a level that is consistent with its size and anticipated use. For example, five-gallon buckets with handles could be stored on a pallet on the floor, while smaller heavy products should be stored on a shelf at waist height to minimize bending and twisting while lifting, which could lead to back or shoulder strain.

- Secondary containers or totes should be used to minimize the flow of material in the event of a spill or container leak. The materials should be segregated by hazard category.

- Do not overcrowd the chemical storage area, which would require you to handle several different containers to get the one you want.

5.4 Laboratory Chemical Segregation

There are a variety of laboratory chemical segregation plans available for use. Some of which are very specialized. They can be based on hazard class or chemical incompatibility. Other plans are derivations from that outlined in the National Research Council's Prudent Practices in the Laboratory: Handling and Disposal of Chemicals. See a partial list of incompatible chemicals in **Appendix E**.

Free download of this book is available from the National Academies Press.

http://www.nap.edu/catalog.php?record_id=4911

Many universities publish diagrams of recommended chemical storage systems on their websites. Chemical supply companies also often have recommended plans for chemical storage in their catalogs or other distributed reference manuals.

Many of these systems are based on a series of codes for functional classes of chemicals. Organic and inorganic chemicals are separated, with sub-groups further separated. The "related and functional storage groups" listed in Prudent Practices and the shelf storage codes often assigned to these groups are listed below. ("I" refers to inorganic compounds and "O" refers to organic compounds.)

Shelf Storage Codes	Related And Functional Storage Groups
INORGANICS	
I-1	Metals, hydrides
I-2	Halides, sulfates, sulfites, thiosulfates, phosphates, halogens
I-3	Amides, nitrates (except ammonium nitrate), nitrites, azides
I-4	Hydroxides, oxides, silicates, carbonates, carbon
I-5	Sulfides, selenides, phosphides, carbides, nitrides
I-6	Chlorates, perchlorates, chlorites, hypochlorites, peroxides
I-7	Arsenates, cyanides, cyanates
I-8	Borates, chromates, manganates, permanganates
I-9	Inorganic acids
I-10	Sulfur, phosphorus, arsenic, phosphorus pentoxide
ORGANICS	
O-1	Organic acids anhydrides, peracids
O-2	Alcohols, glycols, - amines, -amides, -imines, -imides
O-3	Hydrocarbons, esters, aldehydes
O-4	-Amines, -imines, pyridine
O-5	Ethers, ketones, ketenes, halogenated hydrocarbons, ethylene oxide
O-6	Epoxy compounds, isocyanates
O-7	Organic peroxides, hydroperoxides, azides
O-8	Sulfides, polysulfides, sulfoxides, nitriles
O-9	Phenols, cresols

For labs with restricted storage spaces, compatible storage can be provided by grouping chemicals with similar hazards together. These labs could use a simplified system like the one illustrated below.

Inorganic Shelves	Organic Shelves
I-1 & I-10 Sulfur, Phosphorus, Arsenic, Metals, Hydrides (Store All Away From Water!)	O-1 Dry And Dilute Organic Acids, Anhydrides, Peracids
I-2 Halides, Sulfates, Sulfites, Thiosulfates, Phosphates, Halogens	O-5 & O-7 Organic Peroxides, Azides
I-5 & I-7 Sulfides, Selenides, Phosphides, Carbides, Nitrides, Arsenates, Cyanides	O-6 & O-8 Epoxy Compounds, Isocyanates, Sulfides, Sulfoxides, Nitriles
I-4 Dry Hydroxides, Oxides, Silicates, Carbonates	O-9 Miscellaneous Organics: Powdered And Alcohol-free Stains And Indicators

Inorganic Shelves	Organic Shelves
I-3, I-6 & I-8 Nitrates, Nitrites, Borates, Chromates, Manganates, Permanganates, Chlorates, Chlorites, Inorganic Peroxides	Flammable Storage Cabinet Hydrocarbons, Ethers, Ketones, Amines, Halogenated Hydrocarbons, Aldehydes, Alcohols, Glycols, Phenol, Cresol, Combustible Organic Acids, Combustible Anhydrides
Corrosive Acid Storage Cabinet Inorganic Acids. Nitric Acid Stored Separately In This Or Another Cabinet	Corrosive Base Storage Cabinet Or Cupboard Concentrated Liquid Inorganic Hydroxides
Notes *Keep water reactive metals away from aqueous solutions and alcohols.* *Use secondary containers to separate yellow and white phosphorus, which are stored under water, from water-reactive metals.*	

5.5 Safe Chemical Handling

Ensure that all personnel who will be handling chemicals have received the necessary training to do so safely, have reviewed the MSDS, and are using appropriate personal protective equipment. Beyond that, the following guidelines will help you to use all chemicals safely.

Never eat, drink, smoke or chew gum or tobacco while using hazardous chemicals. Always wash your hands after using chemicals, and before eating, drinking, smoking, chewing gum, or applying cosmetics.

Never smell or taste a chemical to identify it - make sure all containers are properly labeled with the chemical's identity and hazards.

Keep containers of flammable and volatile materials closed when not in use to prevent the risk of fire and inhalation exposure. Other containers should also be closed when not in use to prevent a spill if it is accidentally knocked over.

Keep your work area organized. Always return chemicals to their proper storage location after use, or before leaving work for the day.

Check the expiration date and condition of chemicals before you use them. Remove any that have expired or that show signs of deterioration.

5.6 Compressed Gas Cylinders

The safe handling of compressed gas cylinders is critically important because compressed gas cylinders present two hazards. The hazards include: the potentially toxic, corrosive, or flammable chemical hazard associated with the gas itself and the physical hazard of the high pressure gas cylinder. An example of an extreme hazard may occur would be if the cylinder valve gets sheared off in an accidental fall, the cylinder literally would become a rocket that can smash through a cinder block wall.

Planning

Purchase cylinders from companies that will accept the cylinder back. Even non-hazardous compressed gas cylinders can be costly to dispose. Purchase only the size and quantity of cylinders that you need.

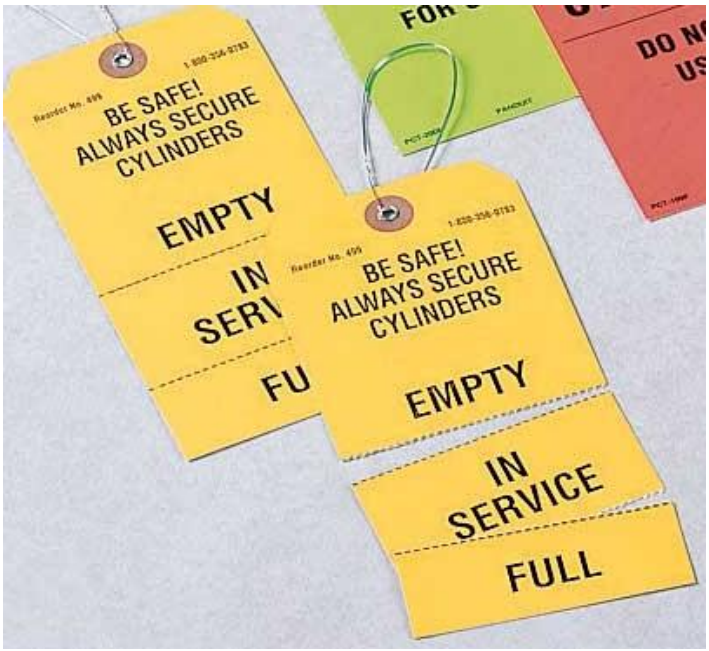
Most high school laboratories are not adequately equipped to safely handle toxic gas cylinders. If considering the use of a toxic gas cylinder for a demonstration, seriously evaluate whether you really need and can safely store and use the product.

Do not rely on color coding to identify the contents of a compressed gas cylinder. There is no universal standard. Different manufacturers use different color codes. Always check the label. Do not use cylinders with missing or illegible labels.

Safe Storage

When the cylinder is not in use, the valve protection cap must be in place to protect the valve. Never drag, slide or roll the cylinder – get a cylinder cart or truck and use it. The cylinder must be secured to the cart during transport. Never transport the cylinder with the regulator in place – have the valve protection cap on.

Cylinders must be secured at all times to a wall, lab bench, cylinder storage rack, or welding cart. Use an appropriate material to secure the cylinder: chain, wire rope, straps, etc. The support should contact the cylinder at a point approximately 2/3 of its height.



Cylinder Tags

Don't store gas cylinders in public hallways or other unprotected areas. Gas cylinder storage should also be segregated by hazard class. Flammable gas should be stored either at least 20 feet from oxygen and oxidizers, or separated by a one-hour fire-rated wall.

When a cylinder is empty, mark "Empty" or "MT" on the cylinder or tag, or tear off the last strip if it has a perforated status tag. Empty cylinders must still be segregated and properly supported.

Safe Use

Check the cylinder for damage before use. Make sure the cylinder has the correct regulator. Do not use grease or oil on the regulator or cylinder valve, especially with oxygen – an explosion may result.

Only open the cylinder valve with a regulator in place. Open the valve all the way – do not leave the valve part way open. When the cylinder is not in use, close the valve, even if it is empty – air and moisture may enter through the open valve, causing contamination and corrosion.

Tanks of acetylene should only be used in the upright, valve on top position. The acetylene gas is dissolved in liquid acetone inside the tank. Do not use copper or bronze fittings or tubing on acetylene tanks as this may cause an explosion. All oxygen/acetylene setups must have a flashback arrestor check valve at the regulators.

Do not heat a cylinder to raise the pressure of the gas. The cylinder has a temperature-sensitive safety device to prevent overpressure, and heating the cylinder could cause it to activate, releasing the gas. Similarly, do not allow the cylinder to be near sparks or open flames, or to come into contact with electric wires.

See the NIOSH School Chemistry Laboratory Safety Guide for further compressed gas cylinder safety suggestions.

http://www.cdc.gov/niosh/docs/2007-107/cylinders.html

6.0 MINIMIZING THE USE OF HAZARDOUS CHEMICALS

6.1 General Strategies

The accumulation of excess chemicals requiring disposal can be controlled by practicing good chemical purchasing practices. As identified in Section 1.3, the chemical coordinator, in cooperation with affected staff, should evaluate and implement strategies for reducing the use of hazardous chemicals in all areas of the school or school district. A good starting guide is the reference manual "Laboratory Waste Minimization and Pollution Prevention: A Guide for Teachers in Pennsylvania."

http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-65448/0130-BK-DEP3171.pdf

Elimination, Substitution and Reduction

Elimination: The preferred method of chemical use minimization is to eliminate the hazardous chemical. If the operation that uses the hazardous chemical is not necessary, and can be eliminated, do so. Consider implementation of a banned chemical list of specific compounds which are not permitted on campus in any form or dilution.

Substitution: Check to see if there is a non-hazardous or less-hazardous material that can be substituted for the hazardous one. Choose "green" or biodegradable cleaners, instead of hazardous solvents. Choose digital electronic thermometers and barometers, instead of the mercury versions. Also, choose low VOC and water-based, instead of oil paint.

Reduction: If there is no substitute, try to reduce the quantity of the hazardous chemical that is used each time the operation is performed, such as using a more dilute concentration, or using microchemistry techniques in the laboratory (see Section 6.2.2).

The following techniques also will help reduce the purchase of excess hazardous materials.

- Share existing stocks of infrequently-used chemicals within the school or school district instead of purchasing new. Once the inventories are complete, the chemical coordinator will know what materials are available when chemical requests are being processed. Compare incoming chemical requests with existing inventories to see if the material is already available.

- Limit the quantity of chemical that is purchased to what will be used. Factor the cost of disposal into the purchase price when evaluating bulk purchase discounts.

- Also consider the costs for any special training, handling, storage and risk control requirements for the hazardous material prior to purchasing. If the material were to spill, do you have the training and equipment to clean it up, or will a contractor need to be brought in? What special personal protective equipment will be required to use the material or clean up a spill?

- Evaluate the schools facilities for storage of the material. Some chemicals must be stored in a ventilated room, and only used in a laboratory-style hood.

6.2 Best Management Practices for Science Laboratories

School science laboratories and the associated store rooms typically have the greatest number of hazardous materials, although they are generally present only in small amounts. Some of these chemicals may be very hazardous. The science department should explore different methods of reducing both the number of different hazardous materials used, and the quantity of each.

The following strategies should be considered:

- Perform demonstrations and experiments that do not use hazardous materials.
- Substitute hazardous materials with less hazardous alternatives.
- Use reduced-scale or micro-scale techniques when available to reduce wastes.
- Purchase needed chemicals in the smallest quantity needed. This can reduce waste and leftover materials in case procedures are changed, expiration dates pass or spills occur. Ask if your vendor will accept unopened containers for disposal or resale.
- Use container dates to see how quickly chemicals are used. Bar coding systems are now available to track inventory.
- Work with the chemical coordinator to see if other schools or departments have materials that you can use, and vice versa.

Green Chemistry

Substitution of hazardous chemicals with less hazardous or even non-hazardous chemicals can greatly reduce the amount of hazardous waste generated in the laboratory. Often, common household chemicals can be used as substitutes for expensive laboratory chemicals in a given experiment. Vinegar and ammonia can be substituted in conventional acid-base experiments. Various solutions of sugar water and salt water can be used for density determination experiments. The household chemicals are usually less hazardous and safer to use, making disposal easier and less costly.

King County in Washington State has developed a program called Rehab the Lab to help local schools reduce the use of hazardous chemicals. Lesson plans for experiments using less hazardous chemicals can be downloaded at no cost from their website:

http://www.lhwmp.org/home/educators/rehabthelab.aspx

Reduced-Scale Chemistry

Typical science class experiments are designed without considering the quantities of waste generated. Most experiments can easily be scaled down by half or more using standard glassware, with a corresponding reduction in waste. In micro-scale chemistry, quantities can sometimes be scaled down by a factor of 1,000 using specially designed glassware and experiments.

If you do not have the resources to perform true micro-scale chemistry, try decreasing experimental quantities by a third or half. A 50% reduction in quantities can usually be achieved with conventional glassware. Such scale reductions may require a few trial runs to ensure that the desired experimental results are achieved.

Practicing reduced-scale or micro-scale chemistry provides additional benefits:

- It reduces chemical use promoting waste reduction at the source.
- It reduces laboratory cost for chemicals.
- It lowers glass breakage cost.
- Better laboratory air quality.
- It offers improved laboratory safety.
- Less exposure to toxic chemicals.
- Reduced fire and explosion hazard.
- Spills and accidents are smaller and result in less exposure.
- It requires shorter experiment time.
- It saves storage space.
- It improves laboratory skills.

The National Microscale Chemistry Center was established to promote the use of micro-scale chemistry as a means of eliminating toxic waste at the source. Learn more about this topic by visiting this website:

www.microscale.org

The National Small-Scale Chemistry Center provides resources to scale down chemical reagents to volumes and masses 1,000 times smaller than those used in traditional labs by using inexpensive plastic and polymer materials. Learn more about this topic by visiting this website:

www.smallscalechemistry.colostate.edu

Commercially Prepared Kits

Some vendors offer experiment kits that contain pre-weighed reagents and prepared solutions in amounts suitable for a class of 25-30 students. These kits offer several advantages:

- Preparation time for setting up the experiment is greatly reduced,
- The amount of chemicals used is small and solutions are dilute, reducing risk of exposure.
- Weights and concentrations are accurate, helping to ensure a successful experiment.
- The kit includes instructions, explanations, worksheets, and report forms.
- There is very little waste to dispose.

However, disadvantages include students get less practice in weighing chemicals and preparing solutions accurately, and the kits are more expensive than self-prepared experiments.

7.0 CONTROL OF CHEMICAL EXPOSURE RISKS

Personal protective equipment (PPE) is often used when the risk of contact with a hazardous material cannot be otherwise controlled. It is a barrier between the material and the chemical user, either by physically preventing contact, or by filtering the chemical from the atmosphere. PPE is therefore the last line of defense before the chemical contacts the user. As such, it should not be the primary means of controlling the exposure risk.

A risk assessment should be performed to determine what other controls are recommended and feasible before resorting to PPE. Prior to selecting PPE, other exposure risk controls that should be evaluated include chemical elimination, reduction and substitution, implementation of administrative controls, and ventilation.

7.1 Primary Controls

As described in Chapter 6, Elimination, Substitution and Reduction are the preferred methods of reducing the risks of exposure to chemical agents. After exhausting those routes, administrative controls and ventilation strategies should be explored before resorting to PPE.

Administrative Controls: After evaluating and implementing all feasible elimination, substitution, and reduction controls, administrative controls should be evaluated. Administrative controls involve controlling who accesses the hazardous chemicals, how often, and how much of each chemical is present. Access to chemical storerooms should be limited, and the rooms and storage cabinets should be kept locked. Only experienced personnel, who are familiar with the hazards and appropriate exposure controls, should be permitted to handle the chemicals. The chemical coordinator can also control the exposure risk by limiting the quantities of hazardous chemicals purchased and in storage at any one time.

Ventilation: Exposure to airborne hazardous chemicals can also be controlled through the use of ventilation. Two types of ventilation are commonly used: dilution ventilation and local exhaust ventilation.

Dilution ventilation usually involves opening a window or setting up a fan to allow fresh air to come into the room. The building's heating, ventilation and air conditioning (HVAC) system is also a form of dilution ventilation, but not one that is well-suited to controlling exposures to hazardous materials, as it may spread the chemical vapors through the building. Dilution ventilation is typically appropriate when using a cleaner or paint on large surfaces, where the material is not especially hazardous. It would not be appropriate for performing laboratory experiments with volatile chemicals. Dilution ventilation is also used to control the build-up of airborne chemical contaminants in storage areas. If you store large quantities of flammable solvents in one storage area, the ventilation rate is required by regulation to maintain the airborne concentration below 25% of the lower flammable limit.

Local exhaust ventilation is a control that mechanically extracts the airborne dusts, mists, fumes or vapors from the point of generation and removes them from the building. The most common example in a school would be a laboratory-style hood, but other applications, such as welding hoods in metal shop, may also be present. Laboratory fume hoods should not be used for chemical storage. Always store chemicals in the appropriate flammable cabinet, acid cabinet, or chemical stock room.

7.2 The Role of PPE

Even after minimizing the use of hazardous materials, PPE may still be required to reduce the exposure risks to an acceptable level. Anyone at risk of coming into contact with a hazardous material, including accidental contact and spills, should wear appropriate PPE to prevent or minimize exposure.

7.3 Selecting Appropriate PPE

The selection of appropriate PPE requires that you recognize and evaluate each hazard, identify the potential routes of exposure, determine the required performance characteristics of the protective equipment, evaluate the cost of the various options, and then make the selection of appropriate PPE.

PPE Selection Factors

- The types of chemical and physical hazards present;
- OSHA's Personal Protective Equipment Standards specified in 29 CFR 1910.132 through 1910.138;
- Recommended PPE as described in applicable MSDSs;
- Review of PPE chemical compatibility data; and
- PPE deemed appropriate per the chemical coordinator's professional judgment.

7.4 Eye and Face Protection

Whenever there is a risk of a chemical splash to the eyes or face, eye and face protection should be worn. Safety glasses are usually sufficient and should always be required when in the laboratory. Regular corrective glasses are not an adequate substitute for safety glasses with side shields. Prescription safety glasses are available.

Operations, which have a higher risk of splash, or which use higher-hazard chemicals, should be performed with chemical-resistant goggles and a face shield. A face shield alone does not provide sufficient eye protection.

Additionally, Pennsylvania Act 116 – Pennsylvania Eye Safety, promulgated under the Department of Public Instruction (now the Department of Education) requires that:

> "Every teacher, student, visitor, spectator, and every other person in any laboratory or laboratory in public or private schools, colleges and universities who is engaged in or is within the area of known danger created by:

1. the use of hot liquids, solids or gases or caustic or explosive materials, or
2. the milling, sawing, turning, shaping, cutting, grinding or stamping of solid materials, or
3. the tempering, heat treatment or kiln firing of metals and other materials, or
4. gas or electric welding, or
5. the repairing or servicing of vehicles,

shall wear industrial quality eye protective devices at all times while engaged in such activities or exposed to such known dangers."

7.5 Hand and Arm Protection

Gloves are available in a variety of different materials – latex, nitrile, butyl rubber, PVC, neoprene, etc. Each glove offers protection against different chemicals. No one glove is resistant to everything. You must review the manufacturer's specifications on each glove type to determine which is best for your application, considering the chemical, its concentration, and the exposure duration. The specifications for a particular glove will often list breakthrough times for various chemicals. This is the amount of time it takes the chemical to penetrate through the glove material to your hand. If you are using several different chemicals, you may need to switch gloves, or wear multiple layers.

Gloves should be treated as disposable items. As soon as they have come into contact with a chemical, they have started the clock on their breakthrough time, and will not provide the same protection as a new pair.

You may also need arm protection even if you are wearing a long-sleeved shirt. Longer gloves and disposable protective sleeves should be considered if there is a risk of chemical splash to the arms.

7.6 Body Protection

Closed-toe shoes and an apron, lab coat or coverall should be worn when working with hazardous chemicals, depending on the level of risk. Students wearing sandals, flip-flops, or other open toed shoes should not be permitted to work with caustic chemicals or toxic chemicals that can be absorbed through the skin. If safety glasses and gloves are required, then so are closed toe shoes.

The protective clothing should provide good protection against the specific chemicals being used. Cloth lab coats should be laundered by a commercial laundry service, not in your household washing machine, where they could contaminate other clothing. Consider using disposable chemical protective clothing.

7.7 Respiratory Protection

The decision to use respiratory protection should be carefully considered only after evaluating all other control options. If you choose to use respiratory protection, a written respiratory protection program (RPP) will be required. The RPP should describe your procedures on program administration, standard operating procedures, exposure assessments, medical evaluation of respirator wearers, selection of respirators, training, respirator fitting, respirator cleaning, inspection and maintenance, and storage conditions and locations. Only personnel

who have been trained and medically qualified to wear a respirator may use one. See OSHA's respiratory protection web page for additional information.

http://www.osha.gov/SLTC/respiratoryprotection/index.html

A respiratory protection program administrator should be assigned. This person will be responsible for implementation of the overall RPP. This person must have sufficient knowledge of respiratory protection issues, and stay up to date on the latest technology and regulation changes.

The RPP administrator will also be responsible for selection of the proper filter cartridges for air purifying respirators. Different cartridges are required based on the different physical form and toxic characteristics of each chemical. Consult your respirator manufacturer's literature for guidance on which filter types are appropriate for your specific chemical exposure risks.

If you do not have a respiratory protection program and you are performing a job which you think requires a respirator, contact your Department or Curriculum Chair, principal, or school nurse for advice.

8.0 CHEMICAL DISPOSAL

8.1 Defining Hazardous Waste

The generation, management, transportation, and disposal of hazardous waste is regulated by the federal Resource Conservation and Recovery Act (RCRA) of 1976. Pronounced "rick-rah," this law regulates various chemicals and their activities from "cradle to grave" - from the point they are generated as hazardous waste until they are properly destroyed, incinerated, or land-filled.

USEPA has determined that Pennsylvania's hazardous waste regulations and programs are at least as stringent as the federal RCRA program. Thus, USEPA has authorized Pennsylvania to implement its program in lieu of the federal RCRA program.

Excess, used, or waste chemicals require evaluation in order to determine if they should be managed and disposed of as hazardous waste. Some unused commercial chemical products must also be managed as hazardous waste when discarded. To be a *hazardous* waste, the waste must first be classified as a *solid* waste. A solid waste is defined as any solid, liquid, or contained gaseous material that is being disposed, discarded, incinerated, recycled, or is inherently waste-like.

Once a solid waste has been identified, the next step is to determine if it is a hazardous waste, which can be accomplished by deeming the waste as a "characteristic waste" or a "listed waste."

Characteristic Wastes

Characteristic wastes exhibit a hazardous *characteristic* (as defined in Title 40 of the Code of Federal Regulations [CFR] Part 261, Subpart C, Sections 21 through 24).

These wastes are summarized as the following four characteristics:

Ignitable: the waste will *catch fire* under certain conditions.

a. Liquid: has a flash point less than 140ºF (this is the temperature at which enough vapor is emitted to ignite in the presence of a spark/flame). (Example: gasoline, isopropyl alcohol)

b. Non-liquid: will cause fire via friction, absorption of moisture, or spontaneous chemical change. (Example: metal dusts)

c. Compressed Gas: cylinders or aerosol sprays using flammable gases as a propellant. (Example: hydrogen, propane)

d. Oxidizer: initiating combustion by contributing oxygen. (Example: oxygen, peroxides, hypochlorite)

Hazardous Waste Drums

Corrosive: the waste has a very high (12.5 or greater) or low (2 or less) pH. Examples include: battery acid, rust removers, and alkaline cleaning solutions such as ammonium hydroxide.

Reactive: the waste is unstable, reacts violently, explodes, and/or produces toxic fumes when mixed with water or subjected to heat or pressure. Examples include: explosives, alkali metals and certain cyanides, or sulfide-bearing wastes.

Toxic: the waste is harmful or fatal when ingested or absorbed. It will leach toxic chemicals into the soil or groundwater if disposed in a landfill. Examples include wastes that contain high concentrations of heavy metals, such as cadmium, lead, or mercury. Toxic wastes are determined through sufficient generator knowledge or with a test called the Toxicity Characteristic Leaching Procedure (TCLP), which is pronounced "T-clip." This test will analyze the waste to determine if it exceeds allowable concentrations of 39 specific chemical compounds (found in 40 CFR 261.24).

Listed Waste

Listed wastes appear on one of four *lists* published by the USEPA in 40 CFR Part 261, Subpart D, Sections 31 through 33, and described as follows:

F-Wastes: *Non-specific* source wastes include generic wastes commonly produced by industry. Examples include spent halogenated solvents and wastewater treatment sludge from electroplating processes. Many of these wastes are "acutely hazardous" wastes due to their toxicity.

K-Wastes: *Specific* source wastes include wastes from specifically identified industries, such as wood preserving, petroleum refining and organic chemical manufacturing. Examples include sludges, still bottoms, wastewaters, spent catalysts and residues. Schools are not likely to generate this type of waste.

U- & P-Wastes: *Commercial chemical products* are defined by two separate lists: toxic commercial chemical products (U-wastes) and "acutely hazardous" chemical products which are more strictly regulated (P-wastes). Most hazardous waste generated by a school is likely to be from one of the commercial chemical products lists (U or P).

The lists of hazardous waste can be found in 40 CFR 261.31-33.

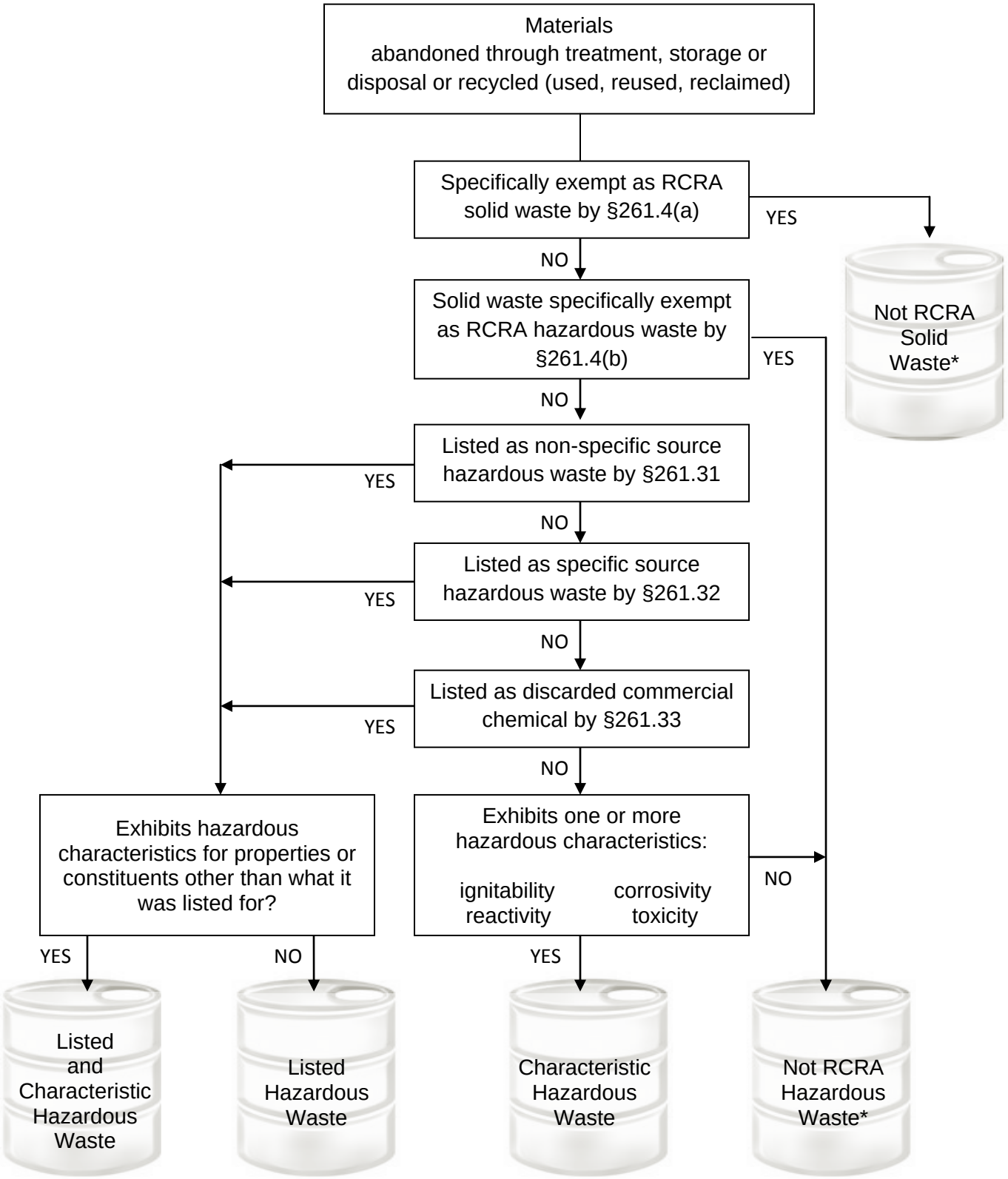
Additional Waste Determination Details

- If the solid waste falls into one of the characteristic or listed categories above, you must continue to manage, store, and properly dispose of the hazardous waste in accordance with state and federal regulations.
- There are some chemicals and wastes that are specifically exempt from hazardous waste regulations as seen in 40 CFR 261.4(b).
- As a safety and precautionary measure, always assume your waste is hazardous.
- Material Safety Data Sheets are helpful resources to provide hazard determinations, as are laboratory tests.
- If you require further assistance in determining your hazardous waste status, contact your local PADEP Office and request the Waste Management Section.

http://www.portal.state.pa.us/portal/server.pt/community/about_dep/13464/office_locations/585263

The aforementioned hazardous waste descriptions are summarized in the following decision tree.

HAZARDOUS WASTE DECISION TREE



* Solid waste may continue to be regulated in Pennsylvania as municipal or residual waste.

8.2 Regulated Hazardous Wastes Commonly Found in Schools

School classes, activities, and programs use hazardous materials and generate hazardous wastes in many different areas of the school. Inspect your school for examples of the following:

School Department	Hazardous Materials
Science Rooms and Laboratories	Flammable liquids (acetone) Oxidizers (bleach) Reactives (picric acid) Toxics (cyanides, phenol)
Technology Education (Graphic Arts, Printing)	Photographic chemicals Dyes Petroleum-based inks Cleaning products
Industrial Arts (Woodworking, Auto Repair and Metal Shops)	Degreasing solvents Petroleum solvents, stains, and paints Cleaning products Welding gases Used oils
Custodial and Maintenance	Cleaning products Petroleum solvents Paints Pesticides Aerosols
Art	Petroleum solvents Glues and adhesives Oil-based paints Glazes with toxic metals Pigments with toxic metals Acids for etching

Your school may have additional specialty departments that utilize additional chemicals.

While the generation of hazardous waste is often unavoidable (as seen in the table above), schools should make efforts to reduce the amount of waste generated, for both resource conservation and cost-saving purposes.

8.3 Determining Generator Category

Since you understand the types of hazardous wastes and have identified areas in your school that generate hazardous waste, you will next need to identify your school's generator category, which is determined by the amount of hazardous waste generated in any calendar month.

Pennsylvania regulations identify three generator categories, each of which is regulated differently as described below:

- Large Quantity Generators (LQG)

  - Generate 1,000 kilograms (about one ton) or more of hazardous waste in any month, or accumulate/generate more than one kilogram of acutely hazardous waste.

  - Accumulate at any time, or generate in one month more than 100 kilograms (about 220 pounds) of any residue, contaminated soil, waste or debris from cleaning up a spill of any acutely hazardous waste onto land or into water.

  - Research universities are typically LQGs.

  - There are stringent LQG requirements for handling, storage, training, transportation, and recordkeeping.

- Small Quantity Generators (SQG)

  - Generate between 100 and 1,000 kilograms (between 220 pounds and one ton) of hazardous waste in any month, or accumulate/generate no more than one kilogram of acutely hazardous waste.

  - Some secondary schools may be SQGs.

  - SQGs are subject to many of the same requirements that apply to LQGs, with the exception of accumulation times and amounts as well as reduced requirements for reporting, emergency preparedness and training.

- Conditionally Exempt Small Quantity Generators (CESQG)

  - Generate less than 100 kilograms (220 pounds) of hazardous waste in any month, or accumulate/generate no more than one kilogram (2.2 pounds) of acutely hazardous waste.

  - Most schools are CESQGs and are required to:
    - Determine if waste is hazardous;
    - Abide by accumulation limits (1,000 kg) (1 ton);
    - Ensure waste goes to an approved facility for proper disposal; and
    - It is recommended that hazardous waste disposal records (manifests) be maintained on site for three years.

Helpful Determination Details

- To determine your school's generator status, add the total weights of hazardous waste and acutely hazardous waste that are generated in one month. These can be ascertained through review of the school's hazardous waste disposal records (*Hazardous Waste Manifests*). *Remember: These manifests should be kept on site for three years. For CESQGs, this is a recommendation, not a requirement.* Ensure the school's current generator status is accurate and has not recently changed.

- For estimation purposes, 220 pounds is about one half of a 55-gallon drum (assuming 8 lbs/gal).

- Universal waste should not be included in calculating hazardous waste. It is a special subset of hazardous waste and includes items, such as: batteries, pesticides, thermostats, and fluorescent tubes, which are regulated under reduced regulations. See Section 10 for information on universal waste.

- Your school should be considered as one physical generator address (the art, maintenance, and all other departments should be combined and viewed as one entity). Separate schools within the school district should be handled as separately entities.

- Properly manage empty containers. "Empty" is defined as all waste has been removed and no more than 1" of residue remains or no more than 3% by weight of the total capacity of the container remains. Note: aerosol cans are only considered empty when they are at atmospheric pressure and empty of liquid contents.

- Refer to 25 PA Code Chapters 260a-270a, and the PADEP Hazardous Waste Compliance Guide and fact sheets for additional information on waste disposal, generation, accumulation, and reporting requirements.

  http://www.depweb.state.pa.us/portal/server.pt/community/hazardous_waste/14078

8.4 Container Management

Hazardous waste should always be stored in appropriate containers in a safe and secure location. Doing so can prevent unneeded exposure to human health and the environment.

Hazardous Waste Container Requirements

- Labeled as "Hazardous Waste";
- Kept closed except when adding/removing waste;
- Maintained in good condition;
  - No sign of rust
  - No dents/creases
  - No bulging heads (over-pressurized)
- Compatible with the waste stored in it; and
- Marked with the date accumulation begins.

8.5 Disposal Options

The final and crucial part of hazardous waste management is disposal (the "grave" of "cradle to grave").

Once you have properly identified and safely accumulated hazardous waste, it's time to find an appropriate transporter and disposal facility to dispose of the hazardous waste.

LQG/SQG Disposal: Use Approved Contractors

If your school is a LQG or SQG:

- Ensure your waste is properly identified, packaged, and labeled prior to transport;
- Retain the services of a Pennsylvania licensed hazardous waste transporter to properly take the waste to a regulated and approved treatment, storage, or disposal facility;
- Ensure you retain the manifest as a record. It will include the types and quantities of the wastes transported and the contact information of the transporter and disposal facility. These must be retained for three years on site from the shipment date. PADEP inspectors will request these manifests during an inspection;
- Ensure that the personnel at the school who are handling, packaging, and labeling waste have been properly trained and maintain the appropriate up-to-date certifications; and
- School representatives may NOT transport hazardous waste in any vehicles.

CESQG Disposal: Use Approved Contractors or Pursue Other Options

If your school is a CESQG: Before you hire a contractor to manage the waste, there are a few options to consider:

Return the Product: In the event that the useful shelf life is past due on a certain chemical or you no longer use that chemical, contact the manufacturer or distributor to determine if they will take back the product. You may be able to get a credit for future purchases if the chemical is still saleable. *(This is also available to LQGs and SQGs).*

Offer to Other Departments: Determine if another department within the school and/or school district can use the chemical or product. Remember, it's not a waste until it's been deemed discarded or abandoned. *(This is also available to LQGs and SQGs).*

Treat the Product: Some chemicals can be chemically destroyed. This should only be attempted if personnel fully understand the chemical properties and adhere to correct methodology. Appropriate PPE should be worn at all times. (For example a solution containing heavy metals can be considerably reduced in volume if the heavy metals are precipitated out, rendering a small pile of heavy metals and a neutral, non-hazardous solution.) *Remember these activities require a permit, such as a Permit-by-Rule. (This is also available to LQGs and SQGs).*

Household Hazardous Waste Events: CESQG's may take hazardous waste to household hazardous waste collection events, provided that the sponsor of the collection is willing to accept the waste. A number of collection sites or centers are located across Pennsylvania and offer proper treatment and disposal for small quantities of wastes including paints and other chemicals typically found around the house. Sponsors of the collections may charge a fee for acceptance of the waste. Some may also accept wastes from CESQG schools. Please be aware that Department of Transportation standards for transportation of hazardous materials must be met when taking the hazardous waste to the collection site. Not all sponsors of household hazardous waste collections accept hazardous waste generated by a CESQG. Please check with the sponsor prior to taking waste to the collection site.

Visit the PADEP Household Hazardous Waste website for helpful information, locations, and rules for specific pickup events:

http://www.portal.state.pa.us/portal/server.pt/community/household/14079

Use Approved Contractors: as described above. *(CESQGs may transport hazardous waste themselves to an approved destination facility).*

Lab Packs: used to manage and dispose small quantities of hazardous waste (unused residual chemical materials). These include unneeded chemicals or mercury contained in thermometers. Packing and shipping should be handled by specific waste vendors coordinating the Lab Pack shipment.

Disposal Warnings

HAZARDOUS WASTES SHOULD NEVER BE DUMPED IN ANY DRAINS, SEPTIC TANKS, OR STORM SEWERS. I*t's against federal and state laws, and may result in severe civil and criminal penalties starting at $25,000 per day and jail time!* Doing so can have significant effects on: piping, infrastructure, publicly owned treatment works (that may be unable to properly treat the waste), and the surrounding environment including: streams, wetlands, soil, and groundwater. If untreated waste enters these areas, it will contaminate a variety of media and dramatically impact human health, flora, and fauna.

DO NOT MIX HAZARDOUS WASTES.

Do not mix non-hazardous waste with hazardous waste. (Doing so only creates more hazardous waste, which creates higher disposal costs.)

Non-hazardous Waste Disposal

If your school has chemicals that you have determined are wastes, but are not *hazardous wastes,* there may be disposal options other than hiring a non-hazardous waste disposal contractor, including:

Evaporation: This process can reduce the volume of a solution, but is allowed only for non-hazardous solvents, such as water. *Hazardous solvents should never be permitted to evaporate as they give off hazardous vapors which will affect human health and air quality.*

Drain Disposal: This option is only for non-hazardous liquids and should be undertaken only after permission has been received from the publicly owned treatment works (POTW). *Water-reactive chemicals should never be disposed of down the drain.*

Trash Disposal: If chemicals are non-hazardous, they can be disposed in a landfill or incinerator. *First, request and verify permission with your waste disposal firm.*

Note: care should always be exercised with these non-hazardous waste disposal methods. these are not acceptable disposal practices for hazardous wastes.

8.6 Chemical Inventory

Schools should conduct an inventory analysis at least once annually. Remove chemicals which are no longer used. Do not let unused chemicals remain on the shelf for excessive periods of time without removal, as some chemicals become increasingly unstable over time.

9.0 SPILL MANAGEMENT

Most, if not all, spills are preventable! However, some spills are also inevitable. Thus, the best way to prevent and manage spills is through **prevention and preparation.**

9.1 Spill Prevention

In a school setting, the most likely places for spills are in science laboratories, technology education, industrial arts, printing and graphics, custodial, maintenance, and any other departments that handle hazardous materials. Most of the container sizes likely range from small 10-milliliter glass vials, to 1-gallon jugs, to 5-gallon plastic containers.

As a teacher or administrator, you can help prevent spills in your area through:

Administrative Controls:

- Spend time educating students about potential spills and how they will be managed in your specific area or classroom.
- Avoid purchasing chemicals in bulk-sizes, glass containers, and in excess. All can increase the probability of spills.
- Routinely conduct an inspection of chemical containers and storage locations to identify potential leaks, degraded container conditions, or other deficiencies that can lead to leaks or spills.
- Prevent negligent student behavior including inattentiveness, carelessness, or general horseplay in work areas.

Cleanliness & Physical Controls:

- Maintain housekeeping in all areas and avoid clutter.
- Keep containers closed, except when adding or removing contents.
- Ensure chemicals are properly stored in appropriately-sized containment during long-term storage and during transport between areas or classrooms.

Through these preventative measures, you can hopefully avert the majority of spills in your area.

9.2 Preparation for Spills

After completing the aforementioned prevention methods, you can then become thoroughly prepared to ensure that you and your students are ready, equipped, and trained, to manage a spill.

Safety First:

Your safety and the safety of your students are of utmost importance! Follow these safety procedures to be thoroughly prepared for spills in your area:

- Inform the students of the hazards of the chemicals stored and used in a particular work area or classroom. Ensure that they understand how to protect both themselves and their peers during regular use and during a spill.

- Inform the school nurse of **ALL** chemical types stored in your laboratory, work area, classroom, or storage closet. Clear communication can ensure that the nurse is prepared to treat any injury that results from a spill. These include broken glass cuts, chemical burns, or extreme temperature exposures (e.g. boiling water or liquid nitrogen exposure).

- Ensure that appropriate PPE is available for all students handling chemicals, there is an abundant supply, and that students are properly trained on how to safely use it.

Contingency Planning:

- Prepare an action plan. Outline the various actions that the students, teachers and administrators should perform during a spill. LQGs must develop a written plan. SQGs must post emergency information by the telephone.

- Conduct a practice drill with colored water taking the place of the hazardous material.

- Some schools districts may have administrative controls restricting the roles and responsibilities of students during a spill situation, depending on their grade level. Become familiar with your district's controls and instruct your students accordingly.

- Develop a list of Emergency Spill Clean-Up Contacts to call in the event of a spill. Keep it accessible during chemical activities. The time that the spill occurs is not the time to be browsing the phone book! Schools may find it economically advantageous to obtain price quotes from vendors each year to obtain the best pricing and service from qualified hazardous waste disposal firms.

EMERGENCY SPILL CLEAN-UP CONTACTS

(Examples: maintenance departments or environmental clean-up firms)

	Name:	**Phone:**
1.	_____	_____
2.	_____	_____
3.	_____	_____

Clean-up Materials:

- Spill response products can be commonly found in **SPILL KITS**. Any area storing chemicals should have at least one Spill Kit, depending on the quantity and size of chemicals store there. Use a second spill kit for oil-based liquids.

- Spill Kits can vary in size (5-gallon buckets, to 55-gallon drums, to mobile carts). However, they should all include basic response materials:

  - **Absorbents:** Absorbent pads, vermiculite, kitty litter (clay-based, unscented). Use the correct absorbent for the material that is spilled.

  - **Clean-up Tools:** Dust pan, brush, small shovel, broom. Plastic tools prevent sparking.

  - **PPE:** Goggles with side-shields, neoprene gloves, aprons, coveralls.

- Ensure that spill kit storage locations are:

  - **Accessible:** they should never be stored/locked in a closet or under heavy materials, or located in the same area as the chemicals where a spill would actually prevent access to the spill kit.

  - **Convenient:** Keep spill kits within reach of work stations where chemicals are used and/or stored.

  - **Properly stocked:** Following a spill clean-up event and on a routine basis, check the contents present in the spill kit using a checklist. Replace missing and out-of-date items to ensure that you are prepared for the next spill.

  - **Properly sized:** Make sure to have an appropriately sized spill kit to match your chemical use needs.

9.3 Spill Response

Despite the best prevention and preparation efforts taken to prevent spills, some spills will unavoidably occur. Therefore, you and your students must be equipped, trained, and ready to be attentive responders.

Follow Clean-up Protocol

- Remember the contingency plan that you developed? Now's the time to use it.

- Utilize general safety procedures to maintain a safe and functional classroom environment.

- Prevent overexcitement and chaos from impeding clean-up efforts.

Assess the Spill

- Treat all spills as hazardous. Contents may differ from their containers or labels: sometimes different containers are used for the same product and/or labels are not always replaced or properly labeled. A particularly innocuous looking bottle and puddle could prove to be very corrosive.

- Identify the apparent hazards (toxic, flammable, water reactive, volatile, etc.).

- Call the spill clean-up contractors identified in Section 9.2 if you are unable to contain the spill.

- For spills of materials classified as “hazardous materials”, 911 should be immediately notified.

Clean the Spill

- Remove injured or unneeded personnel from the spill area. Seek appropriate medical attention for those affected.

- Follow decontamination directions found on the product’s MSDS.

- Access the spill kit.

- Wear the appropriate PPE.

- Remove outside hazards: block all nearby drains and remove any sources of ignition.

- Prevent continued spilling: place the container upright or place it in a larger container.

- Contain the spill: surround it with absorbents, pads, or booms.

- For acid spills, sodium bicarbonate ($NaCHO_3$) can be used as both an absorbent and a buffer to neutralize the spill. It can be used as an absorbent for base spills.

- Cover the remainder of the spill with absorbents.

- Once dried, remove the spill materials and any broken items with the broom, shovel, and dust pan. Carefully sweep solid spills and prevent a chemical dust cloud from forming.

- Properly containerize the spill clean-up materials to prevent leaks during disposal.

- Clean the area, tools, and PPE with appropriate detergents/disinfectants as recommended on the MSDS.

- Discard spent/ruined PPE in the same hazardous waste container.

- Ensure that your spill and the clean-up materials used to contain the spill have not created a hazardous waste that requires specific storage and disposal.

Evaluate the Clean-up Effort

Immediately following a spill clean-up effort is the best time for a learning exercise. Solicit input from students to evaluate the clean-up effort:

- Did you follow the contingency plan?
- What methods were performed successfully?
- What failures existed?

- How could future spill clean-up efforts be improved?
- What precautions could be taken to prevent future spills?

9.4 Large Spills & External Contractors

Large spills (>5 gallons) are highly unlikely to occur in a classroom or laboratory. The probability of large spills is higher in a maintenance or chemical storage department where the size and quantity of chemicals are larger.

Depending on the location of the storage center, the possibility may exist for a spill to escape the building and enter the outside environment. If such a case exists, ensure that the building or room has appropriate secondary containment to adequately contain the size of the largest drum or container, should it spill. Call 911 to report the spill.

In the rare event that a large chemical container would break, leak, or spill and create an extremely hazardous condition in the school:

- The room and/or adjoining rooms/school should be evacuated. Move all personnel and students to an upwind location.

- Teachers should verify classroom attendance via a class roster and procedures established in your schools emergency action plan.

- Report the type and location of the chemical spill to 911**.**

- Wear appropriate PPE before sealing-off the area of the leak or spill.

- Only re-enter the building once emergency responders and/or clean-up personnel indicate that spill clean-up activities are complete and it is safe to return.

9.5 Mercury Spills

Background Information

Mercury is a heavy metal with very unique chemical and physical properties that can exist as a liquid, vapor, or within a compound (e.g. methyl mercury).

Exposure to mercury can negatively affect breathing (vapors) and cause corrosive skin burns, birth defects, and central nervous system damage.

The most probable location of mercury in a school is likely in thermometers, thermostats, and fluorescent lamps. Some of these are found only in science laboratories, but thermostats and fluorescent lamps may be contained in every room of a school.

Mercury Spill Prevention

- Ensure your contingency plan includes conditions for mercury clean-ups.

- Purchase mercury clean-up kits.

- Spills exceeding 1 gram of mercury (the amount contained in a thermometer) should be cleaned by a professional environmental clean-up contractor that has the monitoring equipment to screen for mercury vapors.

- Prevent mercury from entering schools: digital and/or alcohol-based thermometers provide excellent alternatives.

- The Mercury-Free Thermostat Act (House Bill 44) of 2008 banned the sale, installation, and disposal of mercury thermostats effective December 8, 2009. It instituted collection and recycling programs for thermostats. More information can be found at:

http://www.portal.state.pa.us/portal/server.pt/community/universal/14083/mercury-free_thermostat_act/623272

Mercury Spill Clean-up

If a mercury spill occurs following a thermometer break or another event that releases beads or vapors of mercury, follow these steps:

Personnel Protection

- Evacuate the area: remove injured or unneeded personnel.

- Prevent mercury splashes and/or cross-contamination during evacuation efforts.

- Seek appropriate medical attention for those affected.

  - Wash skin exposed to mercury with soapy water.
  - Call Poison Control or 911 if someone has inhaled mercury vapors.

Spill Containment & Ventilation

- Immediately close building air returns and turn off room air conditioning to keep vapors from spreading through the building .

- Immediately open windows and use fans to ventilate indoor air vapors to the outside atmosphere.

- Seal-off the spill from the remainder of the building (close the classroom door).

- Prevent the spread of vapors into other areas of the building by turning off the central HVAC system.

Clean-up Methods

- Remove any metal jewelry and wear appropriate PPE.

- Use tools (e.g. plastic tongs) to remove broken glass and properly containerize it using paper towels and zipper top bags.

- CAREFULLY use an index card to sweep mercury beads into a dust pan.

- Deposit mercury beads into a plastic jar. Use an eyedropper if necessary.

- Shaving cream and/or duct tape can be used to remove smaller beads.

- Verify the thoroughness of spill clean-up efforts by using a flashlight to identify glistening beads of mercury that may be sticking to the surface or in floor cracks of the entire room**.**

- Sprinkle powdered sulfur on the spill area to locate any remaining mercury. Sprinkle wet powdered or flaked zinc on the mercury to capture it.

- Place all PPE and clean-up materials in a trash bag and label it "Mercury-Contaminated Spill Clean-up Material."

- Dispose of the waste as hazardous waste.

Final Warnings

- When mercury is dropped, it can splash and roll for great distances. Don't just concentrate clean-up efforts on the area of impact.

- DO NOT use a vacuum cleaner to pick up mercury: it will volatilize and spread the vapor throughout the room.

- DO NOT pour mercury down the drain!

- DO NOT place broken fluorescent bulbs in the regular municipal trash. They should be handled, stored, and disposed as hazardous waste.

- As mentioned in section 3.4.2, mercury contained in thermometers or other devices can be disposed of via Lab Packs in conjunction with various waste vendors. Use caution: mercury contained in unbroken/intact thermometers and ballasts are handled as universal waste.

- Broken mercury materials and mercury clean-up materials are regulated as hazardous waste.

- For more information, visit USEPA's Mercury Releases and Spills Site.

http://www.epa.gov/mercury/spills/

9.6 Aquatic Program Chlorine Management

Depending on the size of your school, your facility may have an indoor swimming pool. Some common chemicals associated school pools include: sodium hypochlorite (bleach), calcium hypochlorite, chlorine, hydrochloric acid, and algae control agents. Each chemical has hazards associated with their handling, use, and storage.

Safe Storage:

- Chlorine gas is highly toxic and corrosive. It should never be used in an unvented, enclosed environment.

- Application should only be performed by trained pool service personnel who are familiar with the appropriate safety precautions.

- Keep emergency contact information posted near the pool chemical storage location. An appropriate fire extinguisher should be readily accessible.

- For more information, consult USEPA's Safe Storage and Handling of Swimming Pool Chemicals document.

http://www.epa.gov/oem/docs/chem/spalert.pdf

9.7 Insecticides, Pesticides, & Herbicides

Insecticides, pesticides, and herbicides may be applied by maintenance personnel or independent contractors in order to control unwanted pests on school property.

Under no circumstances should administration personnel, teachers, faculty, or students apply, use, or handle any liquid, solid, or gaseous pest control agents. Remember that application of these agents require proper training, safety precautions, and regularly updated certifications.

Consult your school's pesticide application policy for further details.

10.0 UNIVERSAL WASTE RULE (UWR)

10.1 Purpose of the Universal Waste Rule

During year 1995, in order to facilitate hazardous waste recycling, the EPA introduced the Universal Waste Rule (UWR) of RCRA. This rule established simplified regulations that preside over the gathering and administration of certain broadly generated waste, designated as universal waste. Universal wastes are subject to separate, reduced standards rather than the entire scope of RCRA's hazardous waste regulations. Substances controlled under the UWR are not required to be calculated as hazardous waste when concluding generator status under RCRA.

Thermostats with mercury switches showing glass ampoule containing mercury.

10.2 Substances Included Within the Universal Waste Rule

Universal wastes identified in the rule include:

- Hazardous waste batteries.
- Fluorescent lamps.
- Mercury-containing devices (thermostats, thermometers, etc.)
- Pesticides that have been retracted, put on hold, or gathered for discarding.
- Oil-based finishes
- Photographic solutions.

See the PADEP Universal Waste fact sheet for additional information.

http://www.elibrary.dep.state.pa.us/dsweb/Get/Document-79505/2510-FS-DEP2723.pdf

10.3 Facilities Controlled Under the Universal Waste Rule

The four regulator categories under the UWR are as follows:

- Small quantity handlers: store less than 5000 kilograms (about five tons) of universal waste at any one time.

- Large quantity handlers: store 5000 kilograms (about five tons) or more of universal waste at any one time.

- Transporters: move universal wastes by air, rail, highway, or water.

- Owners or operators of destination facilities: treat, dispose of, or recycle universal wastes.

10.4 Requirements for Small Quantity Handlers

Most schools will qualify as small quantity handlers of universal waste. The requirements under this rule, for handlers of small quantities, are as follows:

- Prevent discharge of universal wastes by making use of techniques stipulated by EPA.
- Immediately contain inadvertent releases.
- Provide detailed labeling on all universal waste containers.
- May store universal wastes for up to one year.

If storing universal waste for more than a year, the small quantity handler must verify that an extended duration of storage is required in order to facilitate suitable recycling, treatment, or disposal. A conditional exemption may subsist from the UWR if the small quantity handler stores less than 100 kilograms (220 pounds) of waste per month.

10.5 Requirements for Managing Spent Fluorescent Lamps

FLUORESCENT LAMPS

Fluorescent lamps will most likely be the majority of universal waste generated by schools. The amount of mercury in a single lamp is minimal; however, millions of these lamps are disposed each year, causing them to become a key source of mercury discharged into the environment. No matter what the amount, fluorescent lamps (with the exception of those from households) have been prohibited at solid waste incineration facilities. Anyone wishing to dispose of these lamps should always be sure to seek authorization from the appropriate person before discarding them. Any volume of low mercury ("green") lamps can be disposed of in a landfill without breaking the rule; however, many landfills will not accept them. It is suggested that all lamps be managed according to the requirements of the UWR, regardless of quantity:

Universal Waste Container Requirements

- Lamp Storage
  - Fill containers in a manner to minimize the possibility that they will break during transit.
  - Do not over fill containers
  - Do not tape the lamps together. Recycling facilities may reject taped lamps.

Universal Waste Container Requirements cont'd

- Label containers with one of the following:
  - Universal Waste-Lamps
  - Waste Lamps
  - Used Lamps
- Broken Lamps
  - Immediately contain broken lamps in a sealed container marked "Broken Spent Mercury-Containing Lamps for Recycling."
- Employee Training
  - Proper lamp handling
  - Proper packaging
  - Emergency cleanup and containment procedures. Handle all supplies used in a lamp cleanup as hazardous waste.

10.6 Managing Light Ballasts

Older fluorescent light ballasts contain polychlorinated biphenyls (PCBs). Also about 25% of non-PCB ballasts contain di-(2-ethylhexyl)phthalate (DEHP), which is classified by EPA as a hazardous substance. Ballasts should not be disposed of within the everyday trash. Recyclers that handle fluorescent lamps typically also usually accept both PCB and non-PCB ballasts. School officials should check with their recycling and waste companies to be sure that they are handling these types of waste properly.

LIGHT BALLAST

10.7 Managing Hazardous Waste Batteries

- Ordinary alkaline batteries may be disposed of in the trash.
- Other spent batteries, such as lead-acid, nickel-cadmium, lithium ion, and nickel metal hydride should be managed as universal waste. They should be collected in closed containers, labeled "Universal Waste Batteries," "Waste Batteries," or "Used Batteries," and disposed of within one year.

- Retailers that sell lead-acid batteries for automobiles, boats, aircraft, motorcycles, lawn mowers, etc. are required to take them back for recycling as trade-ins for new batteries. The batteries will be recycled at a battery recycling facility.

- Manufacturers of smaller sealed lead-acid batteries (less than 25 pounds) must provide a method of recycling them.

- Household Hazardous Waste Collection Centers may accept nickel-cadmium and other small rechargeable batteries from schools. They may also be recycled through the Rechargeable Battery Recycling Corporation (RBRC).

http://www.call2recycle.org/

11.0 GLOSSARY

Acid
A substance that dissolves in water and releases hydrogen ions (H+); acids cause irritation, burns, or more serious damage to tissue, depending on the strength of the acid, which is measured by pH.

Acute toxicity
Adverse effects resulting from a single dose, or exposure to a substance for less than 24 hours.

Allergy
An exaggerated immune response to a foreign substance causing tissue inflammation and organ dysfunction.

Asphyxiant
A substance that interferes with the transport of an adequate supply of oxygen to the body by either displacing oxygen from the air or combining with hemoglobin, thereby reducing the blood's ability to transport oxygen.

Base
A substance that dissolves in water and releases hydroxide ions (OH-); bases cause irritation, burns, or more serious damage to tissue, depending on the strength of the base, which is measured by pH.

Carcinogen
A substance that causes cancer.

CAS Registry number
An internationally recognized unique registration number assigned by the Chemical Abstracts Service to a chemical, a group of similar chemicals, or a mixture.

Ceiling limit
The maximum permissible concentration of a material in the working environment that should never be exceeded for any duration.

Chemical hygiene plan
A written program that outlines procedures, equipment, and work practices that protect employees from the health hazards present in the workplace.

Chemical hygiene officer
A designated person who provides technical guidance in the development and implementation of the Chemical Hygiene Plan.

Chronic toxicity
Adverse effects resulting from repeated doses of, or exposures to, a substance by any route for more than three months.

Combustible liquid
A liquid with a flashpoint at a temperature lower than the boiling point; according to the National Fire Protection Association and the U.S. Department of Transportation, it is a liquid with a flash point of 100 °F (37.8 °C) or higher.

Compatible materials
Substances that do not react together to cause a fire, explosion, violent reaction or lead to the evolution of flammable gases or otherwise lead to injury to people or danger to property.

Compressed gas
A substance in a container with an absolute pressure greater than 276 kilopascals (kPa) or 40 pounds per square inch (psi) at 21° C, or an absolute pressure greater than 717 kPa (40 psi) at 54° C.

Consumer Product Safety Commission (CPSC)
An independent U.S. Federal regulatory agency that protects the public against unreasonable risk of injury and death associated with consumer products.

Corrosive
A substance capable of causing visible destruction of, and/or irreversible changes to living tissue by chemical action at the site of contact (i.e., strong acids, strong bases, dehydrating agents, and oxidizing agents).

Department of Transportation (DOT)
U.S. Federal agency that regulates the labeling and transportation of hazardous materials.

Environmental Protection Agency (EPA)
U.S. Federal agency that develops and enforces regulations to protect human health and the natural environment.

Explosive
A substance that causes a sudden, almost instantaneous release of pressure, gas, and heat when subjected to sudden shock, pressure, or high temperature.

Exposure limits
The concentration of a substance in the workplace to which most workers can be exposed during a normal daily and weekly work schedule without adverse effects.

Federal Hazardous Substances Act (FHSA)
The Federal Hazardous Substances Act (15 U.S.C 1261-1278), administered by the Consumer Product Safety Commission, requires that certain household products that are "hazardous substances" bear cautionary labeling to alert consumers to potential hazards that those products present and inform them of the measures they need to protect themselves from those hazards. Any product that is toxic, corrosive, flammable or combustible, an irritant, a strong sensitizer, or that generates pressure through decomposition, heat, or other means requires labeling, if the product may cause substantial personal injury or substantial illness during or as a proximate result of any customary or reasonable foreseeable handling or use, including reasonable foreseeable ingestion by children.

Flammable
As defined in the FHSA regulations at 16 CFR § 1500.3(c)(6)(ii), a substance having a flashpoint above 20ºF (-6.7ºC) and below 100ºF (37.8ºC). An extremely flammable substance, as defined in the FHSA regulations at 16 CFR § 1500.3(c)(6)(i), is any substance with a flashpoint at or below 20ºF (-6.7ºC).

Flashpoint
The minimum temperature at which a liquid or a solid produces a vapor near its surface sufficient to form an ignitable mixture with the air; the lower the flash point, the easier it is to ignite the material.

Hazardous substance
As defined in the Federal Hazardous Substances Act (FHSA) at 16 CFR § 1500.3(b)(4)(i)(A), any substance or mixture of substances that is toxic, corrosive, an irritant, a strong sensitizer, flammable or combustible, or generates pressure through decomposition, heat or other means, if it may cause substantial personal injury or illness during or as a proximate result of any customary or reasonably foreseeable handling or use, including reasonably foreseeable ingestion by children.

Hepatotoxin
A chemical that can cause liver damage.

Highly toxic substance
As defined by OSHA (Appendix A of 29 CFR 1910.1200) and in the FHSA regulations at 16 CFR § 1500.3(b)(6)(i), a substance with either (a) a median lethal dose (LD50) of 50 mg/kg or less of body weight administered orally to rats, (b) a median lethal dose (LD50) of 200 mg/kg or less of body weight when administered continuously on the bare skin of rabbits for 24 hours or less, or (c) a median lethal concentration (LC50) in air of 200 parts per million by volume or less of gas or vapor, or 2 mg/L by volume or less of mist or dust, when administered by continuous inhalation for one hour or less to rats.

Ignitable
Capable of bursting into flames; ignitable substances pose a fire hazard

International Agency for Research on Cancer (IARC)
An agency of the World Health Organization that publishes IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans. This publication documents reviews of information on chemicals and determinations of the cancer risk of chemicals.

Incompatible materials
Substances that can react to cause a fire, explosion, violent reaction or lead to the evolution of flammable gases or otherwise lead to injury to people or danger to property.

Ingestion
Taking a substance into the body by mouth and swallowing it.

Inhalation
Breathing a substance into the lungs; substance may be in the form of a gas, fume, mist, vapor, dust, or aerosol.

Irritant
A substance that causes a reversible inflammatory effect on living tissue by chemical action at the site of contact.

Known human carcinogen
A substance for which there is sufficient evidence of a cause and effect relationship between exposure to the material and cancer in humans.

Lacrimation
Excessive production of tears when the eye is exposed to an irritant.

LC50 (Median Lethal Concentration 50)
The concentration of a chemical that kills 50% of a sample population; typically expressed in mass per unit volume of air.

LD50 (Median Lethal Dose 50)
The amount of a chemical that kills 50% of a sample population; typically expressed as milligrams per kilogram of body weight.

Mutagen
A substance capable of changing genetic material in a cell.

National Fire Protection Association (NFPA)
An organization that provides information about fire protection and prevention and developed a standard outlining a hazard-warning labeling system that rates the hazard(s) of a material during a fire (health, flammability, and reactivity hazards).

National Institute for Occupational Safety and Health (NIOSH)
U.S. Federal agency of the Centers for Disease Control and Prevention (CDC) that investigates and evaluates potential hazards in the workplace. NIOSH is also responsible for conducting research and providing recommendations for the prevention of work-related illness and injuries.

National Toxicology Program (NTP)
U.S. Federal interagency program that coordinates toxicological testing programs, develops and validates improved testing methods, and provides toxicological evaluations on substances of public health concern.

Neurotoxin
A substance that induces an adverse effect on the structure and/or function of the central and/or peripheral nervous system.

Occupational Safety and Health Administration (OSHA)
U.S. Federal agency that develops and enforces occupational safety and health standards for all general, as well as, construction and maritime industries and businesses in the U.S.

Oxidizer
A substance that causes the ignition of combustible materials without an external source of ignition; oxidizers can produce oxygen, and therefore support combustion in an oxygen free atmosphere.

Pennsylvania Department of Environmental Protection (PA DEP)
Pennsylvania’s state agency that develops and enforces regulations to protect human health and the natural environment.

Peroxide former
A substance that reacts with air or oxygen to form explosive peroxy- compounds that are shock, pressure, or heat sensitive.

Permissible Exposure Limit (PELs)
The legally enforceable maximum amount or concentration of a chemical that a worker may be exposed to under OSHA regulations.

Personal Protective Equipment (PPE)
Any clothing and/or equipment used to protect the head, torso, arms, hands, and feet from exposure to chemical, physical, or thermal hazards.

pH
A measure of the acidity or alkalinity of a material when dissolved in water; expressed on a scale from 0 to 14.

Radioactive material
A material whose nuclei spontaneously give off nuclear radiation.

Reactivity
The capacity of a substance to combine chemically with other substances.

Reproductive toxicity
Adverse effects on sexual function and fertility in adult males and females, as well as developmental toxicity in the offspring (International Programme on Chemical Safety (IPCS) Environmental Health Criteria 225, Principles for Evaluating Health Risks to Reproduction Associated with Exposure to Chemicals).

Secondary containment
An empty chemical-resistant container/dike placed under or around chemical storage containers for the purpose of containing a spill should the chemical container leak.

Short Term Exposure Limit (STEL)
The maximum concentration to which workers can be exposed for a short period of time (15 minutes).

Systemic
Affecting many or all body systems or organs; not localized in one spot or area.

Teratogen
A substance which may cause non-heritable genetic mutations or malformations in the developing embryo or fetus when a pregnant female is exposed to the substance.

Threshold Limit Value (TLV)
Term used by the American Conference of Governmental Industrial Hygienists (ACGIH) to express the recommended exposure limits of a chemical to which nearly all workers may be repeatedly exposed, day after day, without adverse effect.

Time Weighted Averages (TWA)
The average concentration to which an average worker can be exposed for a normal, 8 hour workday.

Toxic substance
In general, as defined in the FHSA regulations at 16 CFR § 1500.3(b)(5), any substance (other than a radioactive substance) which has the capacity to produce personal injury or illness to man through ingestion, inhalation, or absorption through any surface of the body.

This term is further defined by OSHA and in the FHSA regulations: As defined by OSHA (Appendix A of 29 CFR 1910.1200), a substance with either, a median lethal dose (LD50) of more than 50 mg/kg but not more than 500 mg/kg of body weight administered orally, a median lethal dose (LD50) of more than 200 mg/kg but not more than 1,000 mg/kg of body weight when administered by continuous contact with the bare skin of rabbits, or a median lethal concentration (LC50) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than 2 mg/L but not more than 20 mg/L of mist, fume, or dust, when administered by continuous inhalation for one hour.

As defined in the FHSA regulations at 16 CFR § 1500.3(c)(2)(i), a substance with either, a median lethal dose (LD50) of 50 mg/kg to 5,000 mg/kg of body weight administered orally in rats, a median lethal dose (LD50) of more than 200 mg/kg but not more than 2,000 mg/kg of body weight when administered by continuous contact with the bare skin of rabbits for 24 hours, or a median lethal concentration (LC50) in air of more than 200 parts per million but not more than 20,000 parts per million by volume of gas or vapor, or more than 2 mg/L but not more than 200 mg/L by volume of mist or dust, when administered by continuous inhalation for one hour or less.

Water reactive material
A substance that reacts with water that could generate enough heat for the item to spontaneously combust or explode. The reaction may also release a gas that is either flammable or presents a health hazard.

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Acknowledgements

Thanks to Mr. Don Smith from the Center for Safe Schools and Dr. Steven Dear from the Pennsylvania Department of Education for reviewing and supporting this manual.

Photo Credits

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Section 4.8: Carl Willis

APPENDIX A

Chemical Hazard Information Sources

Labels

Modern chemical labels contain a great deal of information about their contents, including ingredients, directions for use, health concerns, storage and disposal instructions, and the manufacturer's name, address and phone number. The labels of older chemicals often have far less information. Poorly managed chemicals may have missing labels or labels that have deteriorated. Deteriorated labels should be replaced with new labels with the chemical's name, primary hazards, and date of purchase or inventory date.

Material Safety Data Sheets

When a chemical or chemical product is sold, the manufacturer or distributor must supply a Material Safety Data Sheet (MSDS) to the buyer upon request. Many MSDSs are also readily available on the Internet. (Search the name of the chemical or product, plus MSDS, plus manufacturer's name.) MSDSs contain information about the chemical and physical data such as flammability, reactivity and incompatibilities; health effects; spill procedures and government regulations for its transportation and proper disposal. Schools are required to keep an MSDS for every hazardous chemical on their premises. Typically, this is done by keeping a file, containing a copy of each MSDS, in an area near where the chemicals are being stored, so that they are easily available to employees who could come into contact with the chemicals. Check to see if your local fire department needs copies of school chemical inventories and MSDSs. MSDSs also may be researched on the internet at:

www.hazard.com/msds

Chemical safety information may be obtained from NIOSH via the NIOSH Pocket Guide online version.

http://www.cdc.gov/niosh/npg/

Books

Chemical dictionaries provide a quick reference to basic information. Valuable resources include:

The Merck Index: An Encyclopedia of Chemicals, Drugs, & Biologicals, Merck & Co., Inc., Whitehouse Station, New Jersey

Sax's Dangerous Properties of Industrial Materials, John Wiley & Sons, Inc., Hoboken, New Jersey

Analysis

Unlabeled chemicals can sometimes be identified using simple tests. For those unknowns that are suspected of being highly dangerous, it will be necessary to have them identified by a commercial laboratory. Look in your local Yellow Pages, under "Laboratories, Analytical", and ask if they can provide this service.

APPENDIX B

Peroxide-Forming Chemicals

Severe Peroxide Hazard

Spontaneously form explosive peroxides once opened. Chemicals should be disposed of as hazardous waste within three months of opening.

- Butadiene (liquid monomer)
- Chloroprene (liquid monomer)
- Divinylacetylene
- Isopropyl ether
- Potassium amide
- Potassium metal
- Sodium amide
- Tetrafluoroethylene (liquid monomer)
- Vinylidene chloride

Peroxide Concentration Hazard

Chemicals that form explosive peroxides when distilled, evaporated or otherwise concentrated. These chemicals must be tested for peroxides and discarded within six months of opening.

- 1-Phenylethanol
- 2-Butanol
- 2-Cyclohexen-1-ol
- 2-Hexanol
- 2-Pentanol
- 2-Phenylethanol
- 2-Propanol
- 3-Methyl-1-butanol
- 4-Heptanol
- 4-Methyl-2-pentanol
- 4-Penten-1-ol
- Acetal
- Acetaldehyde
- Benzyl alcohol
- Cumene
- Cyclohexane
- Cyclohexanol
- Cyclohexene
- Decahydronaphthalene
- Diacetylene
- Dicyclopentadiene
- Diethyl ether
- Diethylene glycol dimenthyl ether (diglyme)
- Dioxanes
- Ethylene glycol dimethyl ether (glyme)
- Methyl isobutyl ketone
- Methylacetylene
- Methylcyclopentane
- Tetrahydrofuran
- Tetrahydronaphthalene
- Vinyl ethers
- Other secondary alcohols

Shock and Heat Sensitive

These chemicals form explosive peroxides from auto-polymerization and internal peroxide accumulation. The liquid chemicals in this group should be tested for peroxides and discarded within six months of opening.

- Acrylic acid
- Acrylonitrile
- Butadiene (gas)
- Chloroprene
- Chlorotrifluoroethylene
- Methyl methacrylate
- Styrene
- Tetrafluoroethylene (gas)
- Vinyl acetate
- Vinyl chloride (gas)
- Vinylacetylene (gas)
- Vinyladiene chloride
- Vinylpyridine

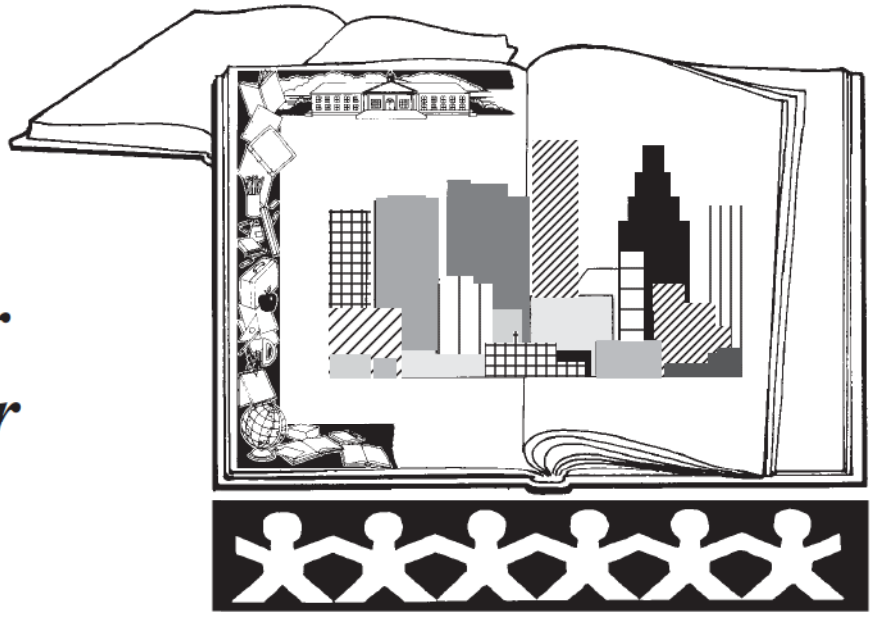
Sources: University of Pittsburgh Safety Manual
Clark, Donald E., Peroxides and Peroxide-forming Compounds, Chemical Health & Safety, September/October, 2001, 12 – 22.

APPENDIX C

Pennsylvania Worker & Community Right to Know Information

PENNSAFE

Compliance Materials for Public Sector Employers



Hazardous Substance Survey Form

COMMONWEALTH OF PENNSYLVANIA
DEPARTMENT OF LABOR & INDUSTRY
PSF-8 REV 12/03

DEPARTMENT OF LABOR & INDUSTRY
COMMONWEALTH OF PENNSYLVANIA

BUREAU OF PENNSAFE
155-E LABOR & INDUSTRY BUILDING
7TH & FORSTER STREETS
HARRISBURG, PA 17120-0019

1-888-SAFE-422 Fax: 717-783-5099 www.dli.state.pa.us

Dear Pennsylvania Employer:

The Pennsylvania Worker and Community Right to Know Act (Act 159 of 1984) requires public sector employers in the Commonwealth to report information about the hazardous chemicals used, produced or stored at their work sites. The law also provides for information about hazardous chemicals to be communicated to Pennsylvania's workers and citizens.

The Pennsylvania Department of Labor and Industry has developed the enclosed material to assist you in reporting information about the hazardous chemicals present at your facility that are regulated by the state Worker and Community Right to Know Act. Enclosed you will find a copy of the Department of Labor and Industry's Hazardous Substance List (amended August 1989). This list includes 2,335 substances that have been identified by the Department to pose health hazards and/or safety concerns to workers and citizens or that have the potential to be hazardous when released into the environment. Chemicals that have been defined by the Department as "Special Hazardous Substances" and "Environmental Hazards" are identified on the list by "S" and "E," respectively.

The packet also contains the current version of the Hazardous Substance Survey Form (HSSF), Option 1 and Option 2, instructions for completing the forms, a sample completed form and general information about the Pennsylvania Worker and Community Right to Know Act. The completed form must be posted in the workplace. It is not necessary to send a copy of the completed HSSF to the Department of Labor and Industry, unless you are sent a written request specifically asking for a copy of the form. If you have any questions about this material or need additional information, please write to the Bureau of PENNSAFE, Department of Labor and Industry, Room 155-E, 7th and Forster Streets, Harrisburg, PA 17120 or phone (717) 783-2071.

Sincerely,

Thomas J. Ward, Jr.
Director

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APPENDIX

GENERAL INFORMATION

Public sector employers throughout the Commonwealth are required by the Pennsylvania Worker and Community Right to Know Act and regulations to annually complete a Hazardous Substance Survey Form (HSSF) by April 1 and post it in the workplace.

The HSSF is a document that has been developed by the Department to collect information about hazardous substances, special hazardous substances and environmental hazards that may be present at a work site.

The purposes of the HSSF are to:

- inform employees about the hazardous substances present at the workplace;
- provide local emergency response organizations with an inventory of hazardous substances at a facility to assist with planning for and responding to emergencies; and
- provide the public with information about hazardous substances at facilities in their communities.

The completed HSSF provides an inventory of the hazardous substances that were present at a work site during the prior calendar year. Employers with more than one facility must complete a HSSF for each site. Each facility HSSF must list the specific hazardous substances found in that particular workplace. It is not necessary to send a copy of the completed HSSF to the Department of Labor and Industry, unless the employer is sent a written request specifically asking for a copy of the form.

Employers have three options for completing the HSSF. Option 1 is the standard form developed by the Department of Labor and Industry. It is most appropriate for workplaces with a small number of hazardous substances. Option 2 is the Department's check-off list. This form is most appropriate for workplaces with many hazardous substances. As a third option, employers may develop and complete their own version of the HSSF; however, it must include all the required information found on Option 1. Employers who use computer software for their chemical inventories find that Option 3 for the HSSF is the most appropriate.

1. Who must comply with the Pennsylvania Worker and Community Right to Know Act?

Under the law, all employers have some compliance responsibilities. The law defines an employer as any individual, partnership, corporation or association doing business in the Commonwealth. The term includes the Commonwealth, its political subdivisions, including school districts, and an officer, board, commission, agency, authority or other instrumentality thereof.

Public sector employers are not subject to the workplace requirements of the federal OSHA Hazard Communication Standard. Therefore, they must comply with the employee access to chemical information and the training provisions of the state law in their workplaces. Public employers must also comply with the community provisions of the state law that provide hazardous chemical information to the public and emergency response organizations; this includes completing the Hazardous Substance Survey Form (HSSF).

2. What substances are regulated under Pennsylvania's Right to Know Act?

The Department of Labor and Industry has developed a list of hazardous substances that are regulated under the state Right to Know Act. This list is known as the Hazardous Substance List (HSL). There are two current versions of this list. The first version of the Department's HSL contains chemicals regulated by the state law that are listed in alphabetical order. This list appears in the Appendix. The second version lists chemicals by order of their Chemical Abstracts Service (CAS) number and is referred to as Option 2 or the Check-Off List. It is usually necessary to reference both lists to complete the Hazardous Substance Survey Form (HSSF) accurately.

3. Does the law provide for any exceptions or exemptions?

The law and regulations exempt the following:

- Articles, as defined as a manufactured item which is formed to a specific shape or design during manufacture, which has end use functions dependent in whole or in part upon its shape or design during end use and which does not release, or otherwise result in exposure to, a hazardous chemical under normal conditions of use;
- Products intended for personal consumption by employees in the workplace;
- Consumer products packaged in containers that are primarily designed for distribution to and use by the general public;
- Products primarily intended for sale on the retail market to the general public;
- Foods, drugs and cosmetics as defined in the Federal Food, Drug and Cosmetic Act;
- Tobacco and tobacco products; and
- Naturally occurring substances such as animal manure and coal.

The following are only exempt from certain provisions of the Act:

- Sealed packages;
- Research and Development Laboratories; and
- Employers without employees.

4. How often must an employer complete the HSSF and what is the deadline for completing this form?

The HSSF must be completed each year by April 1. The report should include hazardous substances that were present at a work site during the prior calendar year. For example, in April 2003, the report should list the hazardous substances at the workplace during January 1, 2002, through December 31, 2002. The April 2004 report will list hazardous substances for calendar year 2003. An employer may update the form as needed, however, only one report per calendar year is required under the law.

5. What quantities of a regulated hazardous substance must be reported on the HSSF?

As a general rule, regardless of the quantity, a hazardous substance should be reported on the HSSF, if the following conditions apply:

1. It does not meet any of the exemptions under the Act;
2. It was present at a work site during the report year; and
3. It appears on the Department's Hazardous Substance List.

6. Should employers report products that are sold over the counter to consumers such as bleach, disinfectants, paints and antifreeze, etc.?

Employers must only report the hazardous substances in these products if an employee's use and exposure to the product is different than the exposure received by a consumer during home usage. Also, if the product in their workplace is present in greater than normal consumer quantities then it must be reported.

7. Should an employer reference any other chemical lists in place of, or in addition to the Department's Hazardous Substance List, to complete the HSSF?

No. Employers must use the Department's Hazardous Substance List to complete the HSSF in order to comply with the requirements of the Pennsylvania Worker and Community Right to Know Act. Other chemical lists may not reference all of the Department's regulated hazardous substances. Only those substances that appear on the Department of Labor and Industry's HSL need to be reported on the HSSF.

8. If an employer chooses to use Option 1, must Column C of the form be completed?

No. Completion of Column C is optional.

Column C of the HSSF (Option 1) was modified to make the reporting for Pennsylvania Right to Know as consistent as possible with similar chemical reporting requirements under SARA Title III. Although the Department encourages employers to complete Column C, it is not mandated in the law or regulations. To complete Column C, simply check the appropriate box(es) for physical and health hazards: fire, sudden release of pressure, reactivity, immediate (acute) and delayed (chronic). The physical and health hazards are usually indicated on the product label and the Material Safety Data Sheet (MSDS).

9. If a workplace includes separate buildings, how should employers complete the report?

A workplace is defined as a building or work area or contiguous group of buildings or work areas at one geographical location composing a plant site in the Commonwealth used by the employer on a permanent or temporary basis to conduct business. Therefore, a workplace can include several buildings at the same location. Complete Part I of the survey for the entire workplace. List the hazardous substances on separate inventory pages (Part II) and indicate which building the inventory page represents.

10. If an employer leases and occupies a portion of a building, must the employer complete the HSSF or is it the landlord's responsibility?

It is the employer's responsibility to complete the HSSF for the portions of the building that the employer leases.

11. If a subcontractor is doing work at a facility and leaves chemical products on the premises, should the employer list the hazardous chemicals found in the subcontractors products on their HSSF?

Yes. Products that are used and stored on the employer's premises should be listed on the HSSF.

12. If there is more than one employer at a specific address, who completes the survey for that location?

Each employer is required to complete the HSSF for their portion of the workplace.

13. Are employers required to send the completed HSSF to the Department of Labor and Industry?

An employer does not have to send a copy of the completed HSSF to the Department unless the Department writes directly to the employer and specifically requests a copy of the form. Public Sector employers are required to post the HSSF in their workplaces.

14. What can employers do if they do not have a Material Safety Data Sheet (MSDS) for a product?

Material Safety Data Sheets are necessary for proper completion of the HSSF. You will need to obtain them from the supplier or manufacturer of the product, in order to determine if the ingredients of the product appear on the Department's HSL. If you have problems obtaining a MSDS from a supplier or manufacturer, try an internet search for the information. Tthe Bureau of PENNSAFE can also provide assistance in obtaining the information.

15. If an employer completes the HSSF, will they also be required to complete the Environmental Hazard Survey Form (EHSF)?

The HSSF and the Environmental Hazard Survey Form (EHSF) are two separate documents. The EHSF is a document that provides information about those hazardous substances on the Department's HSL which are designated as "Environmental Hazards" and are emitted, discharged or disposed of from the workplace. Employers are required to complete this form only when the Department requests them to do so. The form will be provided to an employer with the written request to complete the document.

16. What assistance is available to help employers comply with the Pennsylvania Worker and Community Right to Know Act?

To help employers comply with the law, the Bureau of PENNSAFE offers a variety of training and outreach services. These services include the following:

- On-site Technical Assistance
- Publications
- Employer Consultations
- Training Seminars

17. How can employers obtain additional information?

To obtain additional information about the Pennsylvania Worker and Community Right to Know Act or employers' requirements under the law, contact:

Department of Labor and Industry
Bureau of PENNSAFE
Room 155-E
7th and Forster Streets
Harrisburg, PA 17120

Telephone: (717) 783-2071
Toll Free: 1-888-SAFE-422

FAX: (717) 783-5099

www.state.pa.us
PA Keyword: "pennsafe"

PENNSYLVANIA WORKER AND COMMUNITY RIGHT TO KNOW ACT

The Hazardous Substance Survey Form is only one of the requirements of the Pennsylvania Worker and Community Right to Know Act for public sector employers. Other requirements include:

- Posting a Workplace Notice that lists employee rights under the law;
- Labeling all containers and ports of pipelines containing chemicals/chemical mixtures and hazardous substances/mixtures in the workplace;
- Providing an annual training program for employees exposed to hazardous substances;
- Maintaining employee health and exposure records and making these records available to employees;
- Completing an Environmental Hazard Survey Form (EHSF), if requested by the Department of Labor and Industry, and making it available to employees;
- Completing and posting a Hazardous Substance Survey Form (HSSF), annually, by April 1 and providing it to the Department of Labor and Industry, if requested; and
- Providing upon written request, copies of the HSSF, MSDSs and EHSF to local emergency response organizations.

HAZARDOUS SUBSTANCE SURVEY FORM

Pennsylvania Worker and Community Right to Know Act: Option 1

PART I

1. NAME OF EMPLOYER Dixon Castings Corporation		2. FEDERAL EMPLOYER IDENTIFICATION NUMBER 28-6315379	
3. DIVISION OR PLANT NAME Same		4. WORKPLACE COVERED BY THIS FORM Same	
5. STREET ADDRESS OF WORKPLACE 1360 Clearfield Avenue	CITY Claremont	STATE PA	ZIP CODE 17119
6. MAILING ADDRESS (IF DIFFERENT)			
7. TELEPHONE NUMBER (215) 569-4033	8. COUNTY NAME Montgomery	COUNTY CODE 46	
9. NAME OF EMPLOYER OR EMPLOYER REPRESENTATIVE John G. Dusmond	TITLE Plant Supervisor	DATE 4/1/●	
10. BUSINESS ADDRESS OF SIGNATORY Same			
11. ALL HAZARDOUS SUBSTANCES PRESENT AT WORKPLACE DURING PRIOR YEAR: FROM 1/1/● THRU 12/31/●			
12. SIGNATURE OF EMPLOYER OR EMPLOYER REPRESENTATIVE			

E ● ● INDICATES ENVIRONMENTAL HAZARDS

S ● ● INDICATES SPECIAL HAZARDOUS SUBSTANCE

E	S	CHEMICAL ABSTRACTS SERVICE NUMBER (A)	LIST PRODUCT NAME, THEN LIST THE CHEMICAL NAME OF HAZARDOUS INGREDIENT(S) (B)	PHYSICAL AND HEALTH HAZARD(S)* (C) (Check all that apply) FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVITY	IMMEDIATE (ACUTE)	DELAYED (CHRONIC)
E	S	7440-02-0	Nickel					X
								X
E		7439-96-5	Manganese					
			Celastic Solvent					
E		78-93-3	Methyl Ethyl Ketone	X			X	X
			Degreaser 1810					
E		67-72-1	Hexachloroethane				X	X
E	S	50-00-0	Formaldehyde	X			X	X

SAMPLE

***Physical and health hazards (fire, sudden release of pressure, reactivity, immediate or acute, delayed or chronic) may be found on the product label and Material Safety Data Sheet.**

HAZARDOUS SUBSTANCE SURVEY FORM

Pennsylvania Worker and Community Right to Know Act: Option 1

PART II

1. NAME OF EMPLOYER	2. FEDERAL EMPLOYER IDENTIFICATION NUMBER
Dixon Castings Corporation	98-7654321
3. WORKPLACE COVERED BY THIS FORM	4. DATE
Same	4/1/

E . . . INDICATES ENVIRONMENTAL HAZARDS

S . . . INDICATES SPECIAL HAZARDOUS SUBSTANCE

E	S	CHEMICAL ABSTRACTS SERVICE NUMBER (A)	LIST PRODUCT NAME, THEN LIST THE CHEMICAL NAME OF HAZARDOUS INGREDIENT(S) (B)	PHYSICAL AND HEALTH HAZARD(S)* (C) (Check all that apply)				
				FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVITY	IMMEDIATE (ACUTE)	DELAYED (CHRONIC)
			Master Build Up Metal Solvent					
E		78-93-3	2- Butanone	X			X	X
			Master Plaster Release					
			Stoddard Solvent	X				X
E		75-09-2	Methylene Chloride					
		75-28-5	Isobutane	X	X		X	X
		74-98-6	Propane	X	X		X	X
E		108-88-3	Toluene	X			X	X

***Physical and health hazards (fire, sudden release of pressure, reactivity, immediate or acute, delayed or chronic) may be found on the product label and Material Safety Data Sheet.**

APPENDIX

- Instructions for Completion of the Hazardous Substance Survey Form (HSSF)
- Hazardous Substance Survey Form, Option 1 (Blank Form)
- Hazardous Substance Survey Form, Option 2, Part I and Part II (Check-Off Hazardous Substance List)
- Hazardous Substance List (Alphabetical Listing by Chemical Name)
- Compliance, Training and Outreach Materials Order Form

INSTRUCTIONS FOR COMPLETION OF THE HAZARDOUS SUBSTANCE SURVEY FORM (HSSF)

PENNSYLVANIA WORKER AND COMMUNITY RIGHT TO KNOW ACT

The Hazardous Substance Survey Form lists the hazardous substances, special hazardous substances, and environmental hazards found in the workplace. The employer must provide the following information on this form:

Item 1 Employer Name.

Item 2 Federal Employer Identification Number.

This number can usually be obtained from the company's accounting department, budget or comptroller's office.

Item 3 Division or Plant Name.

Item 4 Workplace Covered By This Form.

The name of the specific workplace for which the Hazardous Substance Survey Form is being completed. A workplace is defined by the Act as "Any building or work area or contiguous group of buildings or work areas at one geographical location composing a plant site in the Commonwealth used by the employer on a permanent or temporary basis to conduct business."

Item 5 Street Address of the Workplace.

The actual/physical location of the workplace.

Item 6 Mailing Address.

The mailing address for the workplace if different from the street address.

Item 7 Telephone Number.

The appropriate telephone number (including area code and extension) to receive calls regarding the Hazardous Substance Survey Form.

Item 8 County Name and Code.

The county name and code from the table below showing the location of the workplace.

Pennsylvania Counties and Codes

COUNTY	CODE	COUNTY	CODE	COUNTY	CODE	COUNTY	CODE
Adams	01	Clinton	18	Lackawanna	35	Pike	52
Allegheny	02	Columbia	19	Lancaster	36	Potter	53
Armstrong	03	Crawford	20	Lawrence	37	Schuylkill	54
Beaver	04	Cumberland	21	Lebanon	38	Snyder	55
Bedford	05	Dauphin	22	Lehigh	39	Somerset	56
Berks	06	Delaware	23	Luzerne	40	Sullivan	57
Blair	07	Elk	24	Lycoming	41	Susquehanna	58
Bradford	08	Erie	25	McKean	42	Tioga	59
Bucks	09	Fayette	26	Mercer	43	Union	60
Butler	10	Forest	27	Mifflin	44	Venango	61
Cambria	11	Franklin	28	Monroe	45	Warren	62
Cameron	12	Fulton	29	Montgomery	46	Washington	63
Carbon	13	Greene	30	Montour	47	Wayne	64
Centre	14	Huntingdon	31	Northampton	48	Westmoreland	65
Chester	15	Indiana	32	Northumberland	49	Wyoming	66
Clarion	16	Jefferson	33	Perry	50	York	67
Clearfield	17	Juniata	34	Philadelphia	51	Out-of-State	99

Item 9 **Name of Employer or Employer Representative; Title; Date.**

The name and title of the Employer or Employer Representative responsible for the information on the Hazardous Substance Survey Form. Provide the date the form was prepared.

Item 10 **Business Address of Signatory.**

The business address of the Employer or Employer Representative completing the Hazardous Substance Survey Form.

Item 11 **Report Period.**

The report period is for the entire prior calendar year.

Item 12 **Signature of Employer or Employer Representative.**

The person responsible for the information on the form and who can be contacted for additional information must sign the form. The signature must be the same name that appears in Item 9.

In listing workplace hazardous chemicals on Hazardous Substance Survey Form Option 1:

Employers are encouraged to first list the name of the product containing the hazardous chemical(s) and then list the substance name of the hazardous chemical as it appears on the Hazardous Substance List. Place a check mark in the appropriate box for the physical and/or health hazard(s) posed by the product.

Information about physical and health hazards (fire, sudden release of pressure, reactivity, immediate (acute), delayed (chronic) may be found on the product label and Material Safety Data Sheet. Definitions of hazard categories are as follows:

- Fire hazard, includes "flammable," "combustible liquid," "pyrophoric" and "oxidizer."
- Sudden release of pressure, includes "explosive" and "compressed gas."
- Reactive hazard, includes "unstable reactive," "organic peroxide" and "water reactive."
- Immediate (acute) health hazard, includes "highly toxic", "toxic", "irritant", "sensitizer", "corrosive" and other hazardous chemicals that cause an adverse effect to a target organ which usually occurs rapidly as a result of short term exposure.
- Delayed (chronic) health hazard, includes "carcinogens" and other hazardous chemicals that cause an adverse effect to a target organ and the effect of which occurs as a result of long term exposure and is of long duration.

If the substance is an environmental hazard, insert an 'E' in the appropriate block. If the substance is a special hazardous substance, insert an 'S' in the appropriate block. If neither is applicable, no blocks should be marked.

A Chemical Abstracts Service (CAS) number is the unique identification number assigned to chemicals by the Chemical Abstracts Service, a division of the American Chemical Society. Provide the Chemical Abstracts Service number as it appears on the Hazardous Substance List. If a substance has no Chemical Abstracts Service number, leave this item blank.

In listing workplace hazardous chemicals on Hazardous Substance Survey Form Option 2:

Complete Items 1 through 12 on Part I. Enter "X" for all hazardous substances present at the workplace on Part II. Indicate the Federal Employer Identification number on upper right portion of each sheet that contains an "X" for a hazardous substance present at the workplace.

HAZARDOUS SUBSTANCE SURVEY FORM

Pennsylvania Worker and Community Right to Know Act: Option 1

PART I

1. NAME OF EMPLOYER		2. FEDERAL EMPLOYER IDENTIFICATION NUMBER ☐☐–☐☐☐☐☐☐☐☐☐	
3. DIVISION OR PLANT NAME		4. WORKPLACE COVERED BY THIS FORM	
5. STREET ADDRESS OF WORKPLACE	CITY	STATE	ZIP CODE
6. MAILING ADDRESS (IF DIFFERENT)			
7. TELEPHONE NUMBER ( )	8. COUNTY NAME		COUNTY CODE
9. NAME OF EMPLOYER OR EMPLOYER REPRESENTATIVE	TITLE		DATE
10. BUSINESS ADDRESS OF SIGNATORY			
11. ALL HAZARDOUS SUBSTANCES PRESENT AT WORKPLACE DURING PRIOR YEAR: FROM / / THRU / /			
12. SIGNATURE OF EMPLOYER OR EMPLOYER REPRESENTATIVE			

E • • INDICATES ENVIRONMENTAL HAZARDS

S • • INDICATES SPECIAL HAZARDOUS SUBSTANCE

E	S	CHEMICAL ABSTRACTS SERVICE NUMBER (A)	LIST PRODUCT NAME, THEN LIST THE CHEMICAL NAME OF HAZARDOUS INGREDIENT(S) (B)	PHYSICAL AND HEALTH HAZARD(S)* (C) (Check all that apply)				
				FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVITY	IMMEDIATE (ACUTE)	DELAYED (CHRONIC)

***Physical and health hazards (fire, sudden release of pressure, reactivity, immediate or acute, delayed or chronic) may be found on the product label and Material Safety Data Sheet.**

HAZARDOUS SUBSTANCE SURVEY FORM

Pennsylvania Worker and Community Right to Know Act: Option 1

PART II

1. NAME OF EMPLOYER	2. FEDERAL EMPLOYER IDENTIFICATION NUMBER

3. WORKPLACE COVERED BY THIS FORM	4. DATE

E • • • INDICATES ENVIRONMENTAL HAZARDS

S • • • INDICATES SPECIAL HAZARDOUS SUBSTANCE

E	S	CHEMICAL ABSTRACTS SERVICE NUMBER (A)	LIST PRODUCT NAME, THEN LIST THE CHEMICAL NAME OF HAZARDOUS INGREDIENT(S) (B)	PHYSICAL AND HEALTH HAZARD(S)* (C) (Check all that apply)				
				FIRE	SUDDEN RELEASE OF PRESSURE	REACTIVITY	IMMEDIATE (ACUTE)	DELAYED (CHRONIC)

***Physical and health hazards (fire, sudden release of pressure, reactivity, immediate or acute, delayed or chronic) may be found on the product label and Material Safety Data Sheet.**

HAZARDOUS SUBSTANCE SURVEY FORM

Pennsylvania Worker and Community Right to Know Act: Option 2

PART I

1. NAME OF EMPLOYER		2. FEDERAL EMPLOYER IDENTIFICATION NUMBER ☐☐–☐☐☐☐☐☐☐☐☐	
3. DIVISION OR PLANT NAME		4. WORKPLACE COVERED BY THIS FORM	
5. STREET ADDRESS OF WORKPLACE	CITY	STATE	ZIP CODE
6. MAILING ADDRESS (IF DIFFERENT)			
7. TELEPHONE NUMBER ( )	8. COUNTY NAME		COUNTY CODE
9. NAME OF EMPLOYER OR EMPLOYER REPRESENTATIVE	TITLE		DATE
10. BUSINESS ADDRESS OF SIGNATORY			
11. ALL HAZARDOUS SUBSTANCES PRESENT AT WORKPLACE DURING PRIOR YEAR: FROM / / THRU / /			

For More Information

Department of Labor and Industry
Bureau of PENNSAFE
155-E Labor and Industry Building
7th and Forster Streets
Harrisburg, PA 17120

Phone: (717) 783-2071
Toll Free: 1-888-SAFE-422

Fax: (717) 783-5099

www.state.pa.us
PA Keyword: "pennsafe"

APPENDIX D

Chemicals with Severe Hazards

Chemical Name	CAS Number	Hazards
Acetaldehyde	75-07-0	Suspect carcinogen. Highly flammable. Peroxide former. Severe irritant to eyes
Acetyl Chloride	75-36-5	Corrosive. Reacts with water & alcohol
Acrolein (acrylaldehyde)	107-02-8	Flammable. Inhalation toxin. Severe irritant. Many incompatibilities. P-listed
Acrylamide	79-06-1	Toxic by absorption, suspected carcinogen
Acrylic Acid	79-10-7	Corrosive. Poison by inhalation & skin absorption. Flammable
Acrylonitrile	107-13-1	Flammable. Poison by inhalation, skin absorption. Carcinogen
Adrenaline (Epinephrine)	329-65-7	Toxic. Theft risk. Drug Precursor
Ammonia, gas cylinders	7664-41-7	Corrosive lachrymator, intense irritant, theft risk
Ammonium Bichromate (Ammonium Dichromate)	7789-09-5	Powerful oxidizer, toxic, carcinogen
Ammonium Bifluoride	1341-49-7	Caustic, poison, severe irritant. Reacts with water, forms hydrofluoric acid
Ammonium Chromate	7788-98-9	Oxidizer, toxic, carcinogen
Ammonium Perchlorate	7790-98-9	Explosive; highly reactive
Aniline	62-53-3	Carcinogen, toxic, absorbs through skin
Aniline Hydrochloride	142-04-1	Poison
Anthracene	102-12-7	Irritant, may cause an allergic skin reaction
Antimony Trichloride	10025-91-9	Corrosive; emits hydrogen chloride gas if moistened
Arsenic Oxide	1303-28-2	Deadly poison & carcinogen. P-listed
Arsenic Trioxide	1327-53-3	Deadly poison & carcinogen. P-listed
Asbestos	1332-21-4	Known human carcinogen
Ascarite II	N/A	Corrosive, may be fatal if ingested
Barium Chromate	10294-40-3	Toxic, oxidizer, carcinogen
Benzene	71-43-2	Flammable. Carcinogen. Toxic

Chemical Name	CAS Number	Hazards
Benzonitrile	100-47-0	Toxic. Organic cyanide reacts with acids to produce poison gas. Combustible.
Benzoyl Chloride	98-88-4	Corrosive. Combustible. Inhalation hazard
Benzoyl Peroxide	94-36-0	Organic peroxide, flammable, oxidizer
Beryllium	7440-41-7	Poison. Dust is P-listed & highly toxic. Carcinogen
Bouin's Solutions	88-89-1	Diluted picric acid. Explosive when dry.
Bromine, concentrated	7726-95-6	Corrosive, oxidizer, volatile liquid, poison fumes
Bromobenzene	108-86-1	Flammable. Toxic. Bioaccumulative pollutant.
Cadmium Chloride	10108-64-2	Toxic heavy metal, carcinogen
Cadmium Nitrate	10325-94-7	Toxic heavy metal, carcinogen. Oxidizer.
Cadmium, powder	7440-43-9	Carcinogen. Poison
Calcium Phosphide	1305-99-3	Emits poisonous, flammable phosphine gas when wet
Calcium Cyanide	592-01-8	May be fatal if inhaled or ingested
Calomel (Mercurous Chloride)	7546-30-7	Extreme poison
Carbon Disulfide	75-15-0	Flammable, poison, P-Listed, reacts with acids to form poisonous H2S gas
Carbon Tetrachloride	56-23-5	Toxic, carcinogen. Bioaccumulative pollutant
Carnoy's Fixative Solution		Chloroform + acetic acid + ethanol. Flammable. Corrosive. Carcinogen
Chloral Hydrate	302-17-0	Hypnotic drug. Controlled substance
Chloretone	57-15-8	Poison. Narcotic. Controlled substance
Chlorine, gas cylinders	7782-50-5	Poison gas. Corrosive.
Chlorobenzene	108-90-7	Flammable, toxic via inhalation & contact. Bioaccumulative pollutant
Chloroethanol	107-07-3	Poison by skin absorption. Can produce acid gas. Flammable.
Chloroform	67-66-3	Carcinogen. If old forms deadly Phosgene gas. Bioaccumulative pollutant
Chlorophenol, p-	106-48-9	Poison by ingestion. Severe irritant. Bioaccumulative pollutant.

Chemical Name	CAS Number	Hazards
Chloroprene	126-99-8	Flammable. Poison. Bioaccumulative pollutant. Affects central nervous system
Chloropromazine	50-53-3	Controlled substance
Chlorosulfonic Acid	7790-94-5	Toxic inhalation hazard. Highly corrosive. Bioaccumulative pollutant
Chromic Acid	7738-94-5 1308-14-1	Strong oxidizer. Poison. Carcinogen. Corrosive.
Chromium Trioxide	1333-82-0	Oxidizer. Poison. Carcinogen.
Colchicine	64-86-8	Deadly poison. Affects cell division. Severe eye irritant.
Collodion	9004-70-0	Flammable. Explosive when dry. Ether/Nitrocellulose compound.
Copper Cyanide	544-92-3	Severe poison. P-Listed. Releases poison gas when acidified even slightly.
Corrosive Sublimate (Mercury Bichloride)	7487-94-7	Poison by ingestion and skin absorption (when wet). Corrosive.
Creosote	8001-58-9	Carcinogen. Combustible.
o-, m-, and p-Cresol	95-48-7 108-39-4 106-44-5	Corrosive to skin & eyes. Toxic via ingestion, skin absorption.
Cumene	98-82-8	Flammable. Central nervous system depressant. Peroxide former. Explosion risk.
Cyanogen Bromide	506-68-3	Poison. Corrosive. Reacts with acids to form poison gas.
Cyclohexene	110-83-8	Flammable, peroxide former
p-Dichlorobenzene	106-46-7	Combustible, anticipated human carcinogen
Dichloroethane, 1,2- (ethylene dichloride)	107-06-2	Flammable. Toxic. Bioaccumulative pollutant
Diethylamine	109-89-7	Flammable. Corrosive to skin & eyes.

Chemical Name	CAS Number	Hazards
Dimethylaniline	121-69-7	Combustible. Poison by ingestion. Irritant. Central nervous system depressant.
Dinitrophenol, 2,4-	51-28-5	Poison by inhalation, skin absorption. Explosive. “Bomb Squad”
Dinitrophenylhydrazine, 2,4-	119-26-6	Explosion risk
Dioxane, 1,4-	123-91-1	Flammable. Peroxide former. Explosion risk.
Estrone	53-16-7	Steroid. Carcinogen. Theft Risk.
Ethyl Chloride	75-00-3	Extremely flammable. Contact w/water produces corrosive, toxic fumes.
Ethyl Ether (diethyl ether, anhydrous ether)	60-29-7	Flammable. Peroxide former. Explosion risk.
Ethyl Nitrate	625-58-1	Explosive. “Bomb squad”.
Ethylenediamine	107-15-3	Flammable. Toxic by inhalation. Corrosive base.
Ethyleneimine	151-55-4	Flammable. Toxic. P-listed
Ethylene Oxide	75-21-8	Flammable, explosive, toxic, human carcinogen
Formaldehyde (37% Solution)	50-00-0	Toxic. Carcinogen. Severe sensitizer
Furfural	98-01-1	Combustible. Toxic via inhalation & Ingestion. Dangerous to eyes.
Gunpowder	N/A	Explosive, theft risk
Hayem Diluting Fluid	N/A	Contains mercuric chloride. Severe poison.
Hexachlorophene	70-30-4	Fatally toxic by inhalation, ingestion, or skin absorption
Hydrazine	302-01-2	Flammable. Poison by inhalation & skin absorption. Carcinogen. Corrosive to skin.
Hydrazine Sulfate	10034-93-2	Poison. Absorbs through skin. Carcinogen.
Hydriodic Acid	10034-85-2	Corrosive. Toxic by inhalation

Chemical Name	CAS Number	Hazards
Hydrobromic Acid	10035-10-6	Corrosive, fatal if inhaled or ingested
Hydrofluoric Acid	7664-39-3	Corrosive. Poison. Absorbs readily through skin
Hydrogen	1333-74-0	Flammable
Hydrogen Sulfide, gas cylinders	7783-06-4	Poison. Inhalation hazard. Stench
Hydroquinone	123-31-9	Toxic by ingestion & inhalation. Corrosive to eyes & skin.
Isopropyl Ether	108-20-3	Flammable, Highest-risk peroxide former. Explosive. Bomb squad.
Lead Arsenate	7784-40-9	Known human carcinogen, teratogen
Lead Carbonate	1319-46-6	Poison
Lead Chromate	7758-97-6	Highly poisonous. Possible carcinogen. Commonly used in ceramic glazes.
Lithium Metal	7439-93-2	Combustible, water reactive
Lithium Aluminum Hydride	16853-85-3	Flammable solid. Reacts with air, water & organics
Lithium Nitrate	7790-69-4	Oxidizer
Magnesium Metal, powder	7439-95-4	Spontaneous ignition hazard
Magnesium Perchlorate (Anhydrone)	10034-81-8	Powerful oxidizer. Explosive reaction with alcohols.
Mercaptoethanol	60-24-2	Flammable. Corrosive. Intense stench
Mercury	7439-97-6	Corrosive, poison
Mercuric Chloride	7487-94-7	Poison
Mercuric lodide	7774-29-0	Poison
Mercuric Nitrate	10045-94-0	Poison. Oxidizer
Mercuric Sulfate	7783-35-9	Poison
Mercuric Sulfide	1344-48-5	Poison. Reacts with acids to form poisonous hydrogen sulfide gas
Mercurous Chloride	7546-30-7	Poison

Chemical Name	CAS Number	Hazards
Mercurous Nitrate	10415-75-5	Poison. Oxidizer.
Mercurous Sulfate	7783-36-0	Poison
Methyl Iodide (Iodomethane)	74-88-4	May be a narcotic; Carcinogen. Lachrymator.
Methyl Isocyanate	624-83-9	Flammable, dangerous fire risk, toxic
Methylamine	74-89-5	Flammable. Corrosive. Intense stench. Inhalation toxin.
Methyl Methacrylate	80-62-6	Flammable, explosive vapor
Methyl Orange	547-58-0	Possible mutagen
Methyl Red	493-52-7	Possible mutagen
Million's Reagent	N/A	Mercury nitrate + nitric acid. Deadly poison. Highly corrosive.
Naphthylamine, a-	134-32-7	Combustible, Toxic. Carcinogen. Absorbs through skin or lungs
Nessler's Reagent	7783-33-7	Mercury iodide + sodium hydroxide. Deadly poison. Corrosive.
Nickel Metal	7440-02-0	Expected carcinogen, mutagen
Nickel Oxide	1314-06-3	Expected carcinogen, mutagen
Nicotine	54-11-5	Poison. P-Listed Extremely hazardous
Nitrilotriacetic Acid	139-13-9	Confirmed carcinogen. Toxic via ingestion.
Nitrobenzene	98-95-3	Toxic. Combustible. Oxidizer. Absorbs through skin.
Osmium Tetraoxide (Osmic Acid)	20816-12-0	Poison. P-Listed Extremely Hazardous.
Paraformaldehyde	30525-89-4	Releases poisonous formaldehyde gas when heated
Paraldehyde	123-63-7	Flammable. Controlled substance. Poison. Theft risk.
Paris Green	12002-03-8	Poison by inhalation, ingestion, skin absorption

Chemical Name	CAS Number	Hazards
Pentachlorophenol	87-86-5	Extremely toxic. Bioaccumulative pollutant.
Perchloric Acid	7601-90-3	Powerful oxidizer. Highly corrosive. Potential explosive in contact w/metals
Phenol	108-95-2	Combustible, corrosive, poison by inhalation, ingestion, skin absorption
Phosphorus Pentasulfide	1314-80-3	Water Reactive. Toxic. Incompatible with air & moisture
Phosphorus Pentoxide	1314-56-3	Oxidizer. Corrosive. Toxic.
Phosphorus, Red, Yellow or White	7723-14-0	Spontaneously ignites in air. Poison.
Phthalic Anhydride	85-44-9	Corrosive, combustible particles form explosive mixture in air
Physostigmine	57-47-6	P-listed. Toxic
Picric Acid, Trinitrophenol	88-89-1	Explosive when dry. Explosive crystals form in contact with metals.
Potassium, metal	7440-09-7	Water reactive, peroxide former (orange fog/crystals)
Potassium Cyanide	151-50-8	Severe poison. P-Listed. Releases poison gas when acidified even slightly.
Potassium Oxalate	583-52-8	Corrosive, may be fatal if ingested
Potassium Perchlorate	7778-74-7	Powerful oxidizer. Reactivity hazard. Severe irritant.
Potassium Peroxide	17014-71-0	Water reactive. Strong oxidizer.
Potassium Sulfide	1312-73-8	Flammable. Unstable, may ignite spontaneously.
Pyridine	110-86-1	Highly flammable. Toxic by ingestion, inhalation, skin contact
Selenium	7782-49-2	Severe irritant
Silver Cyanide	506-64-9	Severe poison. P-Listed. Releases poison gas when acidified even slightly.
Silver Nitrate	7761-88-8	Oxidizer, corrosive, may be fatal if ingested
Silver Oxide	20667-12-3	Oxidizer

Chemical Name	CAS Number	Hazards
Sodium Arsenate	13464-42-1	Deadly poison. Carcinogen.
Sodium Arsenite	13464-37-4	Deadly poison. Carcinogen.
Sodium Azide	26628-22-8	Poison, explosive reaction with metals. P-Listed Extremely hazardous
Sodium Borohydride	16940-66-2	Flammable solid. Water reactive
Sodium Chromate	7775-11-3	Oxidizer, corrosive, carcinogen
Sodium Cyanide	143-33-9	Severe poison. P-Listed. Releases poison gas when acidified even slightly.
Sodium Dichromate	10588-01-9	Oxidizer, corrosive, carcinogen
Sodium Hydrosulfite (sodium dithionite)	7775-14-6	Water reactive. Toxic by ingestion & inhalation. An allergen, Powerful reducing agent.
Sodium Nitrite	7632-00-0	Oxidizer
Sodium Perchlorate	7791-07-3	Powerful oxidizer. Reactivity hazard. Severe irritant.
Sodium Peroxide	1313-60-6	Water reactive. Strong oxidizer.
Sodium Sulfide	1313-82-2	Corrosive, poison by inhalation or ingestion
Sodium Thiocyanide	540-72-7	Poison by ingestion, contact with acid liberates toxic gas
Stannic Chloride	7646-78-8	Corrosive, form hydrochloric acid on contact with water
Stearic Acid	57-11-4	May form combustible dust concentration in air
Strontium	7440-24-6	Flammable. Store under naphtha. Water reactive.
Strontium Nitrate	10042-76-9	Oxidizer
Sudan IV	85-83-6	Irritant, suspected carcinogen, mutagen
Sulfuric Acid, fuming	8014-95-7	Corrosive, fatal by ingestion, human carcinogen
Sulfur Dioxide, gas cylinder	7446-09-5	Poison gas at high levels. Corrosive irritant to eyes & skin.

Chemical Name	CAS Number	Hazards
Tannic Acid	1401-55-4	Irritant
Testosterone & Testosterone Proprionate	58-22-0 57-85-2	Controlled substance. Steroid. Theft risk.
Tetrabromoethane	79-27-6	Poison by inhalation, ingestion, skin absorption
Tetrahydrofuran	109-99-9	Flammable. Peroxide former. Explosion risk.
Thallium	7440-28-0	Extremely poisonous.
Thioacetamide	62-55-5	Toxic. Carcinogen. Combustible.
Thionyl Chloride	7719-09-7	Corrosive. Violent reaction w/water forms acid gas.
Thiourea	62-56-6	Carcinogen. Poison.
Titanium Tetrachloride	7550-45-0	Toxic inhalation hazard. Highly corrosive.
Titanium Trichloride	7705-07-9	Corrosive. Reacts with water & heat to produce corrosive, toxic fumes.
o-Toluidine	95-53-4	Carcinogen, mutagen
1,1,1-Trichloroethane	71-55-6	Toxic. Ozone depleting chemical. Bioaccumulative pollutant.
Trichloroethylene	79-01-6	Toxic via skin, inhalation. Ozone deplete. Bioaccumulative pollutant. Carcinogen.
Triethylamine	121-44-8	Flammable. Toxic, Irritant.
Trinitrobenzene	99-35-4	Explosive. “Bomb Squad”
Uranium	7440-61-1	Radioactive
Uranyl Acetate	541-09-3	Radioactive
Uranyl Nitrate	10102-06-4	Radioactive. Toxic by ingestion. Oxidizer. Corrosive to skin.
Urethane	51-79-6	Combustible, confirmed carcinogen, teratogen
Vanadium Pentoxide	1314-62-1	Poison via inhalation & ingestion.
Wood’s Metal	8049-22-7	Carcinogen, neurotoxic contains cadmium

APPENDIX E

Incompatible Chemicals

The following list is to be used only as a general guideline. Please refer to your Material Safety Data Sheets (MSDS) for specific incompatibilities.

Chemical:	**Incompatible with:**
Acetic acid	Chromic acid, nitric acid, hydroxyl compounds, ethylene glycol, perchloric acid, peroxides, permanganates
Acetylene	Chlorine, bromine, copper, fluorine, silver, mercury
Acetone	Concentrated nitric and sulfuric acid mixtures
Alkali and alkaline earth Metals	Water, carbon tetrachloride or other chlorinated hydrocarbons, carbon dioxide, halogens
Ammonia (anhydrous)	Mercury, chlorine, calcium hypochlorite, iodine, bromine, hydrofluoric acid (anhydrous)
Ammonium nitrate	Acids, powdered metals, flammable liquids, chlorates, nitrites, sulfur, finely divided organic combustible materials
Aniline	Nitric acid, hydrogen peroxide
Arsenic materials	Any reducing agent
Azides	Acids
Bromine	See chlorine
Calcium oxide	Water
Carbon (activated)	Calcium hypochlorite, all oxidizing agents
Chlorates	Ammonium salts, acids, powdered metals, sulfur, finely divided organic or combustible materials
Chromic acid and chromium trioxide	Acetic acid, naphthalene, camphor, glycerol, alcohol, flammable liquids in general
Chlorine	Ammonia, acetylene, butadiene, butane, methane, propane(or other petroleum gases), hydrogen, sodium carbide, benzene, finely divided metal, turpentine
Chlorine dioxide	Ammonia, methane, phosphine, hydrogen sulfide
Copper	Acetylene, hydrogen peroxide
Cumene hydroperoxide	Acids (organic or inorganic)
Cyanides	Acids
Flammable liquids	Ammonium nitrate, chromic acid, hydrogen peroxide, nitric acid, sodium peroxide, halogens

Chemical:	Incompatible with:
Fluorine	All other chemicals
Hydrocarbons (such as butane, propane, benzene)	Fluorine, chlorine, bromine, chromic acid, sodium peroxide
Hydrocyanic acid	Nitric acid, alkali
Hydrofluoric acid (anhydrous)	Ammonia (aqueous or anhydrous)
Hydrogen sulfide	Fuming nitric acid, oxidizing gases
Hypochlorites	Acids, activated carbon
Iodine	Acetylene, ammonia (aqueous or anhydrous), hydrogen
Mercury	Acetylene, fulminic acid, ammonia
Nitrates	Acids
Nitric acid (concentrated)	Acetic acid, aniline, chromic acid, hydrocyanic acid, hydrogen sulfide, flammable liquids and gases, copper, brass, any heavy metals
Nitrites	Acids
Nitroparaffins	Inorganic bases, amines
Oxalic acid	Silver, mercury
Oxygen	Oils, grease, hydrogen; flammable liquids, solids, and gases
Perchloric Acid	Acetic anhydride, bismuth and its alloys, alchohol, paper, wood, grease, oils
Peroxides, organic	Acids (organic or inorganic), avoid friction, store cold
Phosphorus (white)	Air, oxygen, alkalis, reducing agents
Potassium	Carbon tetrachloride, carbon dioxide, water
Potassium chlorate	Sulfuric and other acids
Potassium perchlorate see also chlorates	Sulfuric and other acids
Potassium permanganate	Glycerol, ethylene glycol, benzaldehyde, sulfuric acid
Selenides	Reducing agents
Silver	Acetylene, oxalic acid, tartaric acid, ammonium compounds, fulminic acid
Sodium	Carbon tetrachloride, carbon dioxide, water
Sodium nitrite	Ammonium nitrate and other ammonium salts

Chemical:	Incompatible with:
Sodium peroxide	Ethyl or methyl alcohol, glacial acetic acid, acetic anhydride, benzaldehyde, carbon disulfide, glycerin, ethylene glycol, ethyl acetate, methyl acetate, furfural
Sulfides	Acids
Sulfuric acid	Potassium chlorate, potassium perchlorate, potassium permanganate (similar compounds of light metals, such as sodium, lithium)
Tellurides	Reducing Agents