Dickinson

CHEMICAL HYGIENE PLAN

April 4, 2023

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Review/Revision Summary

Below is a summary of reviews and revisions made to this document:

Review/Revision Date	Major Changes	Reviewed/Revised By:
May 3, 2000	Original Document	David Stutts, Chemical Hygiene Officer
2/20/2009	Chemical Hygiene Plan Revision & Updates	Bill Shoemaker, Director EHS
5/9/2016	Chemical Hygiene Plan Revision & Updates • Update to include requirements from the 2012 Hazard Communication Standard o Updates to labeling procedures, safety data sheets, and pictograms	Steph Koser, WasteStrategies
9/18/2017	Annual Review	Steph Koser, WasteStrategies
6/5/2018	Annual Review • Added Review and Revision Summary • Minor revisions only	Steph Koser, WasteStrategies
1/31/19	Added Glove Selection Guide (Appendix F), Waste Disposal Guide (Appendix G), and Waste Class Poster (Appendix H) to plan	Daniel Berndt, Dickinson College
4/5/2022	Updated name of current Chemical Safety Officer	Kevin Walters Lauren Lasater Dickinson College
4/18/2023	Annual Review	Kevin Walters Lauren Lasater Dickinson College

1.0 Introduction

1.1 The Laboratory Standard (29 CFR 1910.1450)

In response to questions about the application of the Hazard Communication Standard in certain laboratory settings, on January 31, 1990, the Department of Labor published in the Federal Register an amendment to 29 CFR 1910 Subpart Z, identified as Section 1910.1450. The title of the amendment is "Occupational Exposure to Hazardous Chemicals in the Laboratory", better known as the "Laboratory Standard".

The Laboratory Standard ensures that employees who work in a laboratory setting will be protected from any chemical exposures that exceed permissible exposure limits and that employees will be educated as to the hazardous nature of the chemicals they use in the laboratory. To achieve this goal, the Laboratory Standard requires the college to appoint a Chemical Hygiene Officer to develop, implement, and monitor a Chemical Hygiene Plan.

1.2 Dickinson College Statement of Responsibility

In compliance with the amendment to 29 CFR 1910 Subpart Z, identified as Section 1910.1450, titled "Occupational Exposure to Hazardous Chemicals in the Laboratory", but better known as the "Laboratory Standard," Dickinson College realizes our responsibility for the protection of our employees. We hereby institute the enclosed Chemical Hygiene Plan to assist us in our safety program.

Dickinson College hereby appoints the Director of Compliance & Enterprise Risk Management to be our Chemical Hygiene Officer. We acknowledge the Chemical Hygiene Officer has the knowledge and authority to implement and enforce our Chemical Hygiene Plan.

Although we, Dickinson College, are designating the Director of Compliance & Enterprise Risk Management as our Chemical Hygiene Officer, we realize the success of our Chemical Hygiene Plan rests with all of our employees. The College's environmental health and safety consultant will assist in fulfilling the duties of the Chemical Hygiene Officer, as requested. The ultimate responsibility of the Chemical Hygiene Plan rests with the President of Dickinson College.

1.3 Scope and Application

This document serves as the written guide for Dickinson College compliance to the Laboratory Standard and the Chemical Hygiene Plan (CHP) requirements contained therein. All employees at Dickinson College engaged in the laboratory use of hazardous chemicals are required to comply with this document.

The primary objective of this document is to provide a general guide for handling hazardous chemicals in laboratories. The Chemical Hygiene Plan establishes the basic safety principles for laboratory procedures, equipment and work practices that are capable of protecting employees from physical and health hazards of hazardous chemicals in laboratories. This document is intended only to highlight those safety measures necessary for achieving a safe and healthy work environment. Where the scope of hazards is not adequately addressed by this general document, the laboratory supervisor must develop specific Standard Operating Procedures.

This document will hereafter be known as the Dickinson College Chemical Hygiene Plan (DCCHP).

1.3.1 Definition of a Laboratory

This section identifies facilities within the College that are to be considered a laboratory as defined by OSHA. Activities within these facilities must comply with the Laboratory Standard. Other facilities which use or store hazardous materials must comply with other OSHA standards, including the Hazard Communication Standard and the substance specific standards of 29 CFR 1910.

The following are taken directly from the Laboratory Standard, 29 CFR 1910.1450(b) Definitions:

> *Laboratory* means a facility where the *laboratory use of hazardous chemicals* occurs. It is a workplace where relatively small quantities of hazardous chemicals are used on a non-production basis.
>
> *Laboratory use of hazardous chemicals* means handling or use of such chemicals in which all of the following conditions are met:
>
> A. Chemical manipulations are carried out on a *laboratory scale*
>
> B. Multiple chemical procedures or chemicals are used
>
> C. The procedures involved are not part of a production process, nor in anyway simulate a production process
>
> D. *Protective laboratory practices and equipment* are available and in common use to minimize the potential for employee exposure to hazardous chemicals
>
> *Laboratory scale* means work with substances in which the containers used for reactions, transfers, and other handling of substances are designed to be easily and safely manipulated by one person. Laboratory scale excludes those workplaces whose function is to produce commercial quantities of materials.
>
> *Protective laboratory practices and equipment* means those laboratory procedures, practice and equipment accepted by laboratory health and safety experts as effective, or that the employer can show to be effective, in minimizing the potential for employee exposure to hazardous chemicals.

1.4 Hazardous Chemical Definitions

According to the Hazard Communication Standard (29 CFR 1910.1200), "hazardous chemical" means any chemical which is classified as a physical hazard or a health hazard, a simple asphyxiant, combustible dust, pyrophoric gas, or hazard not otherwise classified. While the Hazard Communication Standard is intended to focus on health effects of chemicals, it and other standards and regulations govern the safe handling of more broadly defined hazardous materials. To meet these expanding health and safety requirements, criteria are presented here for identifying materials which are both health hazards and physical hazards.

Health hazards include chemicals which are carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic systems, and agents which damage the lungs, skin, eyes, or mucous membranes.

Physical hazards include chemicals for which there is scientifically valid evidence that they are combustible liquids, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water reactive.

1.4.1 Toxic Hazard Criteria

A substance will be considered to present a toxic hazard requiring the use of procedures for toxic chemicals when any one of the following criteria are met:

A. The SDS or container label identifies or describes the substance as toxic.

B. The substance meets the definition of toxic in the Hazard Communication Standard (29 CFR 1910.1200 Appendix A), meeting one of the following criteria:

   i. The median lethal dose (LD_{50}) is more than 50 mg/kg of body weight but not more than 500 mg/kg of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

   ii. The median lethal dose is more than 200 mg/kg of body weight but not more than 1000 mg/kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

   iii. The median lethal concentration (LC_{50}) in air is more than 200 ppm by volume of gas or vapor but not more than 2000 ppm by volume of gas or vapor, or more than two mg/L but not more than 20 mg/L of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

C. Any substance whose toxic properties are unknown.

1.4.2 Fire Hazard Criteria

A substance will be considered to present a fire hazard requiring the use of procedures for fire hazards when any one of the following criteria are met:

A. The SDS or container label identifies or describes the substance as flammable or combustible.

B. The substance fits the definition of “combustible liquid” in the OSHA Laboratory Standard (29 CFR 1910.1450):

   - Combustible liquid means any liquid having a flashpoint at or above 100°F but below 200°F, except any mixture having components with flashpoints of 200°F, or higher, the total volume of which make up 99% or more of the total volume of the mixture.

C. The substance fits any of the following definitions of "flammable chemicals" in the OSHA Laboratory Standard (29 CFR 1910.1450):

- "Aerosol, flammable" means an aerosol that, when tested by the method described in 16 CFR 1500.45, yields a flame protection exceeding 18 inches at full valve opening, or a flashback (a flame extending back to the valve) at any degree of valve opening.
- "Gas, flammable" means a gas that, at ambient temperature and pressure, forms a flammable mixture with air at a concentration of 13% by volume or less; or a gas that, at ambient temperature and pressure, forms a range of flammable mixtures with air wider than 12% by volume, regardless of the lower limit.
- "Liquid, flammable" means any liquid having a flashpoint below 100°F, except any mixture having components with flashpoints of 100°F or higher, the total of which make up 99% or more of the total volume of the mixture.
- "Solid, flammable" means a solid, other than a blasting agent or explosive as defined in 29 CFR 1910.109(a), that is liable to cause fire through friction, absorption of moisture, spontaneous chemical change, or retained heat from manufacturing or processing, or which can be ignited readily and when ignited burns so vigorously and persistently as to create a serious hazard. A chemical shall be considered to be a flammable solid if, when tested by the method described in 16 CFR 1500.44, it ignites and burns with a self-sustained flame at a rate greater than one-tenth of an inch per second along its major axis.

1.4.3 Reactivity Hazard Criteria

A substance will be considered to present a reactivity hazard requiring the use of procedures for reactive chemicals when any one of the following criteria are met:

A. The SDS or container label identifies or describes the substance as unstable, reactive, explosive, dangerous when wet, pyrophoric, an oxidizer, or an organic peroxide.

B. The substance fits the definition of unstable (reactive), explosive, organic peroxide, oxidizer, or water reactive in the OSHA Laboratory Standard (29 CFR 1910.1450):

- *Unstable (reactive)* means a chemical which in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shock, pressure, or temperature.
- *Explosive* means a chemical that causes sudden, almost instantaneous release of pressure, gas, or heat when subjected to sudden shock, pressure, or high temperature.
- *Organic peroxide* means an organic compound that contains the bivalent –O—O— structure and which may be considered ~~to be~~ a structural derivative of hydrogen peroxide where one or both of the hydrogen atoms have been replaced by organic radicals.

- *Oxidizer* means a chemical other than a blasting agent or explosive as defined in 1910.109(a), that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.
- *Water-reactive* means a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

C. The substance fits the definition of pyrophoric in the Hazard Communication Standard (29 CFR 1910.1200):

- *Pyrophoric* means a chemical that will ignite spontaneously in air at a temperature of 130°F or below.

1.4.4 Corrosivity Hazard Criteria

A substance will be considered to present a corrosivity hazard requiring the use of procedures for corrosive chemicals when any one of the following criteria are met:

A. The SDS or container label identifies or describes the substance as corrosive

B. The substance fits the OSHA definition of corrosive in the Hazard Communication Standard (29 CFR 1910.1200 Appendix A):

- *Corrosive* means a chemical that causes visible destruction of, or irreversible alterations in, living tissue by chemical action at the site of contact. For example, a chemical is considered corrosive if, when tested on the skin of albino rabbits by the method described by the U.S. Department of Transportation in Appendix A to 49 CFR part 173, it destroys or changes irreversibly the structure of the tissue at the site of contact following an exposure period of four hours. This term shall not refer to action on inanimate surfaces.

1.4.5 Contact Hazard Criteria

A substance will be considered to present a contact hazard requiring the use of procedures for contact hazards when any one of the following criteria are met:

A. The SDS or container label identifies or describes the substance as an allergen, irritant, or sensitizer.

B. The substance fits the OSHA definition of an “irritant” or “sensitizer” in the Hazard Communication Standard (29 CFR 1910.1200 Appendix A):

- *Irritant* means a chemical, which is not corrosive, but which causes a reversible inflammatory effect on living tissue by chemical action at the site of contact. A chemical is a skin irritant if, when tested on the intact skin of albino rabbits by the methods of 16 CFR 1500.41 for four hours exposure or by other appropriate techniques, it results in an empirical score of five or more. A chemical is an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques.
- *Sensitizer* means a chemical that causes a substantial proportion of exposed people or animals to develop an allergic reaction in normal tissue after repeated exposure to the chemical.

1.4.6 Particularly Hazardous Substance Criteria

A substance will be considered a particularly hazardous substance requiring the use of procedures for particularly hazardous substances when any of the following criteria are met:

A. The SDS or container label identifies or describes the substance as a carcinogen, reproductive toxin, or highly toxic.

B. The substance meets the definition of "highly toxic" in the Hazard Communication Standard (29 CFR 1910.1200), described by one of the following criteria:

   i. The median lethal dose (LD_{50}) is equal to or less than 50 mg/kg of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

   ii. The median lethal dose is equal to or less than 200 mg/kg of body weight when administered by continuous contact for 24 hours (or less if death occurs within 24 hours) with the bare skin of albino rabbits weighing between two and three kilograms each.

   iii. The median lethal concentration (LC_{50}) in air is equal to or less than 200 ppm by volume or less of gas or vapor, or equal to or less than 2 mg/L of mist, fume, or dust, when administered by continuous inhalation for one hour (or less if death occurs within one hour) to albino rats weighing between 200 and 300 grams each.

C. The substance meets the definition of a "select carcinogen" in the Laboratory Standard (29 CFR 1910.1450), described by one of the following criteria:

   i. The substance is regulated by OSHA as a carcinogen.

   ii. The substance is listed under the category, "known to be carcinogens," in the latest Annual Report on Carcinogens published by the National Toxicology Program (NTP).

   iii. The substance is listed under Group 1 ("carcinogenic to humans") by the latest International Agency for Research on Cancer Monographs (IARC).

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

      a. After inhalation exposure of 6—7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages less than 10 mg/m^3.

      b. After repeated skin application of less than 300 mg/kg of body weight per week.

      c. After oral dosages of less than 50 mg/kg of body weight per day.

D. The substance fits the definition of "reproductive toxins" in the OSHA Laboratory Standard (29 CFR 1910.1450):

- *Reproductive toxins* means chemicals which affect the reproductive capabilities including adverse effects on sexual function and fertility in adult males and females, as well as adverse effects on the development of the offspring.

Use the SDS to address chronic toxicity. For further help in determining the hazard of a chemical, contact your supervisor or the Chemical Hygiene Officer.

1.4.7 Compressed Gas Hazard Criteria

A substance will be considered to present a compressed gas hazard requiring the use of procedures for compressed gases when any of the following criteria are met:

A. The SDS or container label identifies or describes the substance as a compressed gas.

B. The substance meets the definition of a "compressed gas" in the Laboratory Standard (29 CFR 1910.1450), described by one of the following criteria:

- A gas or mixture of gases having, in a container, an absolute pressure exceeding 40 psi at 70°F.
- A gas or mixture of gases having, in a container, an absolute pressure exceeding 104 psi at 130 °F regardless of the pressure at 70°F.
- A liquid having a vapor pressure exceeding 40 psi at 100°F as determined by ASTM D-323-72.

1.5 Responsibility

A. **The President of the College** has ultimate responsibility for chemical safety within the institution. General oversight responsibility is assigned to the **Provost of the College**.

B. **The Chemical Hygiene Officer** advises on matters of material safety policies and practices and:

1. Works with administrators and other employees to develop and implement the appropriate chemical hygiene policies and practices.
2. Monitors procurement, use, and disposal of chemicals used in the lab.
3. Ensures that appropriate audits are conducted.
4. Helps laboratory supervisors develop precautions and adequate facilities.
5. Knows the current legal requirements concerning regulated substances.
6. Seeks ways to improve the Chemical Hygiene Plan.
7. Conducts information and general training sessions.
8. Handles requests for monitoring air and/or surface contamination by hazardous materials.
9. Assists with the investigation of accidents involving hazardous materials.

10. Provides necessary information to the healthcare professional when a report of possible overexposure occurs.
11. Schedules testing of laboratory facilities.
12. Schedules services for hazardous waste disposal.
13. Maintains a resource file of references and publications on safety matters.
14. Writes, or assists laboratory supervisors in writing standard operating procedures pertinent to their needs.
15. Maintains the file of safety data sheets for hazardous materials used in College laboratories.

C. **The Department Chair** is responsible for chemical hygiene in his or her department and:

1. Ensures that action is taken to correct work practices and conditions that may result in the release of hazardous materials.
2. Implements the DCCHP for those laboratories where the laboratory supervisors do not exercise primary discretion in the choice of hazardous materials used or stored in their laboratories.

D. **The Laboratory Supervisor** is the faculty or staff member under whose instruction hazardous materials are used and/or stored in the laboratory. The supervisor has a primary responsibility for implementing the DCCHP in the laboratory, and:

1. Ensures that workers know and follow the chemical hygiene rules.
2. Ensures that training specific to the laboratory's procedures and chemicals has been provided.
3. Ensures that the required level of personal protective equipment is available, in working order, and that specific training in its use has been provided.
4. Knows the current legal requirements concerning regulated substances used in the laboratory.
5. Ensures that facilities and training for use of any material being ordered is adequate.
6. Provides for the safety of visitors in the laboratory.
7. Prepares procedures for dealing with accidents that may result in the unexpected exposure of personnel or the environment to a hazardous material.
8. Maintains the inventory of hazardous materials use under his or her supervision.
9. Sees that work areas where particularly hazardous substances or select carcinogens are used or stored are properly identified.

10. Oversees the handling of chemical waste pending proper disposal.

E. **The Laboratory Worker** must be alert to and aware of the hazards of the materials with which he or she is working, and:

1. Maintain a thorough understanding of the DCCHP.
2. Plan and conduct each operation in accordance with the DCCHP.
3. Report all incidents, whether involving personnel, equipment, or facilities to their supervisor.

F. **The Associate Vice President for Campus Operations** has the responsibility for the continuous operation of the laboratories, including engineered safety devices, and:

1. Regularly tests (or contracts for services to test) and maintains safety showers, eyewashes, fume hoods, fire extinguishers, fire pumps, sprinklers, and fire alarm systems.
2. Maintains negative pressure in designated work areas.
3. Reviews construction, modification, and renovation plans for safety design.

G. **The Department of Compliance and Enterprise Risk Management** has the responsibility for ensuring laboratories are operated in a safe manner, and:

1. Provides regular, formal chemical hygiene and housekeeping inspections including routine inspections of emergency equipment (e.g., regular tests of eyewash fountains).

H. **The Department of Compliance and Enterprise Risk Management, in conjunction with the Department of Public Safety** has general responsibility for personal safety and:

1. Schedules and conducts fire drills and emergency and disaster drills.
2. Responds to medical incidents of overexposure, provides treatment and assessment and determines the appropriate transportation.

I. **All Employees of the College** are responsible for ensuring that they follow the procedures and faithfully implement the appropriate responsibilities put forth in the Chemical Hygiene Plan. Failure to do so is a serious breach of College policy and subject to disciplinary action that might include termination of employment at the College. The procedures to be followed in the event of such action shall be in keeping with existing guidelines as stated in the appropriate handbook for faculty, administrators, or staff.

Personnel currently in the responsible positions referenced above include:

Position	Name
President of the College	John Jones
Provost of the College	Renée Cramer

Associate Vice President for Campus Operations	Kristen Kostecky
Director of Public Safety	Dolores Danser
Chemical Hygiene Officer	Lauren Lasater

1.6 Employee Rights

It is the employee's right to receive information about the known physical and health hazards of the hazardous chemicals in their work areas and to receive adequate training to work safely with these substances. Employees have the right to work in a safe environment and inform their laboratory supervisor about potential risks in the laboratory.

1.7 Availability

The Dickinson College Chemical Hygiene Plan must be readily available to employees and employee representatives through their supervisor or the Chemical Hygiene Officer.

1.8 Periodic Review

The Dickinson College Chemical Hygiene Plan will be reviewed periodically by the Dickinson College Safety Committee.

1.9 Employee Information and Training

Employees must have access to information and training to ensure that they are apprised of the hazards of chemicals present in the work area. Such information must be provided at the time of an employee's initial assignment to a work area where hazardous chemicals are present and prior to assignment involving new exposure situations. Employees should receive periodic refresher information and training to ensure that they are aware of the risks of exposure to hazardous chemicals.

1.9.1 Information

Information provided by the Chemical Hygiene Officer/Department Head/Lab Supervisor to employees must include:

A. The contents of the Laboratory Standard and its appendices.

B. The location and availability of the DCCHP.

C. The permissible exposure limits for OSHA regulated substances or recommended exposure limits for other hazardous chemicals where there is no applicable OSHA standard.

D. Signs and symptoms associated with exposures to hazardous chemicals used in the laboratory (available on Safety Data Sheets).

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

1.9.2 Method of Training

General training will be provided by the Chemical Hygiene Officer, or their designee, and may take the form of individual instruction, group seminars, audiovisual presentations, handout material, or any combination of the above. Site-specific training shall be provided by laboratory supervisors or an appropriate designee.

1.9.3 Training

General awareness training provided by the Chemical Hygiene Officer, or their designee, to employees will include:

A. Methods and observations that may be used to detect the presence or release of a hazardous chemical (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released, etc.).

B. General physical and health hazards of chemicals in the work area.

C. The measures employees can take to protect themselves from these hazards, including specific procedures the College has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used.

D. The applicable details of the DCCHP.

Site-specific training provided by laboratory supervisors (or designees) to employees will include:

A. Site-specific standard operating procedures.

B. Specific physical and health hazards of chemicals in the work area (available on Safety Data Sheets).

1.9.4 Documentation

The Chemical Hygiene Officer will document general awareness training required by the CHP. Site-specific training must be documented and maintained by the laboratory supervisor.

1.10 Record Keeping

The Chemical Hygiene Officer will retain records of all employees who attend the general awareness training.

It is required that records of specific laboratory training for individual laboratories be retained by the supervisor in the laboratory or the department.

Accident records for employees should be written and retained within the laboratory or unit. The amount of time a unit chooses to retain training records is not specified in the Laboratory Standard. It is recommended by this document that such records be retained for at least one year after an employee leaves a position. Ideally, training records should be retained indefinitely. The Laboratory Standard requires that the following records be maintained for at least thirty (30) years and that they are kept, transferred, and made available in accordance with 29 CFR 1910.1020:

A. Employee medical records

B. Employee exposure records

C. Analyses using exposure or medical records

D. Environmental and biological monitoring or measuring results

2.0 General Standard Operating Procedures

The College has developed generic standard operating procedures (SOP's) relevant to safety and health considerations when laboratory work involves the use of hazardous chemicals. Where the scope of hazards are not adequately addressed by this general document, department chairs/laboratory supervisors must develop written standard operating procedures for work area specific substances (see Section 4.0). Standard operating procedures must be provided to all affected laboratory employees. **The Standard Operating Procedures in this document specify minimum regulations and recommendations**.

2.1 General Safety Principles

The following guidelines have been established to minimize hazards and to maintain basic safety in the laboratory.

A. Examine the hazards associated with the materials being used by carefully reading the label and reviewing the Safety Data Sheet.

B. Know the location and proper use of emergency equipment (e.g., fire alarms, fire extinguishers, emergency eyewash, and shower stations) and know the appropriate emergency response procedures.

C. Use appropriate safeguards for each chemical in use, including personal protective equipment.

D. Know the proper storage for chemicals when not in use.

E. Use proper methods of transporting chemicals within the facility.

F. Always be alert to unsafe conditions and actions and call attention to them so that corrective action can be taken.

G. Avoid distracting or startling other workers when they are handling hazardous chemicals.

H. Always inspect equipment for leaks, tears, and other damage before handling a hazardous chemical. This includes fume hoods, gloves, goggles, etc.

I. Use proper personal hygiene practices.

2.2 Health and Hygiene

The following practices have been established to protect laboratory employees from health risks associated with the inhalation, ingestion, injection, or absorption of hazardous chemicals:

A. Avoid direct contact with any hazardous chemical. Know the types of protective equipment available and use the proper type for each job.

B. Do not mouth pipette.

C. Do not eat, drink, smoke, chew gum, or apply cosmetics in the laboratory.

D. Wear leather gloves when inserting glass tubing into cork or rubber stoppers.

E. Pick up broken glass using tongs.

F. Wear appropriate eye protection at all times.

G. Confine long hair and loose clothing and always wear footwear that fully covers the feet.

H. Wash thoroughly with soap and water after handling chemicals, before leaving the laboratory and before eating or drinking.

I. Wash immediately if skin or eye contact is made with any chemical, regardless of corrosivity.

J. Do not sit on lab benches.

K. Remove all personal protective equipment, including gloves and goggles, before leaving the laboratory.

L. Change clothing as soon as possible after leaving the laboratory and launder work clothes often.

2.3 Food and Drink in The Laboratory

The following statement is the accepted practice on food and drink in laboratories and should be followed at all times:

> "There shall be no food, drink, smoking or applying cosmetics in laboratories which have radioactive, biological, or chemical hazards present. There shall be no storage, use or disposal of these 'consumable' items in laboratories (including refrigerators within laboratories). Rooms which are adjacent, but separated by floor to ceiling walls, and do not have any radioactive, biological, or chemical hazards present, may be used for food consumption, preparation, or applying cosmetics at the discretion of the laboratory supervisor responsible for the areas."

2.4 Housekeeping

Sensible housekeeping practices contribute greatly towards chemical hygiene and safety. Use the following guidelines to maintain an orderly laboratory:

A. Keep work areas clean and uncluttered with chemicals and equipment.

B. Clean up work areas upon completion of an operation or at the end of each workday, including floors.

C. Do not block exits or access to emergency equipment including safety showers, eyewashes, and fire extinguishers.

D. Do not block hallways or stairs.

E. Clean spills immediately and thoroughly, as per the guidelines established in Section 5.0 of this document. Ensure a chemical spill kit is available and that employees know how to use it.

F. Keep wastes in their proper containers and label them appropriately.

G. Ensure hazardous chemicals are properly segregated into compatible categories and placed in an appropriate storage area (see Section 6.1.3 of this document).

H. Ensure all chemical containers are labeled with both the name of the chemical(s) and the hazards they present.

I. Treat any unlabeled containers at the end of the workday as waste.

J. Suspend all work in an affected laboratory when repairs or modifications of the facilities are being carried out, even if that work is being conducted outside of the laboratory setting.

2.5 Chemical Handling and Storage

The decision to use a hazardous chemical should be a commitment to handle and use the chemical properly from initial receipt to disposal.

A. Information on proper handling, storage and disposal of hazardous chemicals and access to related Safety Data Sheets should be made available to all laboratory employees prior to the use of the chemical.

B. Always purchase the minimum amount necessary to maintain operations. Conduct periodic inventories and discard unneeded items or return them to the stockroom.

C. Chemical containers with missing or defaced labels, or that violate appropriate packaging regulations should not be accepted.

D. Chemicals utilized in the laboratory must be appropriate for the laboratory's ventilation system.

E. Chemicals should not be stored on high shelves and large bottles should be stored no more than two feet from floor level.

F. Chemicals shall be segregated by compatibility.

G. Chemical storage areas must be labeled as to their contents (see Section 6.1)

H. Storage of chemicals at the lab bench or other work areas shall be kept to a minimum.

I. Avoid exposure of chemicals to heat or direct sunlight.

J. Any chemical mixture shall be assumed to be as toxic as its most toxic component.

K. Substances of unknown toxicity shall be assumed to be toxic.

2.6 Transporting of Chemicals

When transporting chemicals precautions should be taken to avoid dropping or spilling chemicals.

A. Carry glass containers in specially designed bottle carriers or a leak resistant, unbreakable secondary container (e.g., a five-gallon plastic bucket).

B. When transporting chemicals on a cart, use a cart that is suitable for the load and one that has high edges to contain leaks or spills.

C. High-traffic areas should be avoided, and, when possible, transport chemicals in freight elevators to avoid the possibility of exposing people on passenger elevators.

2.7 Unattended Operations

At times, it may be necessary to leave a laboratory operation unattended. Follow these basic guidelines in the design of an experiment to be left unattended:

A. Develop a protocol for potential interruptions in electric, water, inert gas and other services and provide containment for toxic substances as part of the protocol.

B. A warning notice must be posted in the vicinity of the experiment if hazardous conditions are present (e.g., on the laboratory door).

C. Leave lights on in the laboratory.

D. Never leave an operation unattended if it involves the use of particular hazardous substances (as described in Section 1.4).

2.8 Working Alone

A. Working alone in a laboratory is dangerous and should be strictly avoided whenever possible. Coworkers should always be present and should coordinate schedules to avoid working alone.

B. If you must work alone outside of normal working hours, the laboratory supervisor must be notified and the Department of Public Safety must be notified prior to commencing work, at regular intervals during work, and when completed with work.

C. Never work alone with particularly hazardous substances (as described in Section 1.4) or substances of unknown toxicity.

2.9 Prior Approval

Any new procedure should be subjected to review to ensure that all safety considerations are in place prior to implementation. Approval from the laboratory supervisor to proceed must be obtained if any of the following criteria are met:

A. The procedure or task is a new one.

B. There is a change, substitution, or deletion in the procedure or task.

C. There is a substantial change in the amount of chemicals used.

D. There is a failure of any of the equipment used in the process or task (e.g., fume hoods).

E. There are unexpected test results, in which case a review of how the new result impacts safety practices must be made.

F. Laboratory staff suspect exposure, detects a chemical's odor, or otherwise suspects a failure of any safeguards.

G. Members of the laboratory staff will be working alone or a procedure or a task will be unattended.

H. A particularly hazardous substance is used.

2.10 Storage and Disposal of Hazardous Waste

For guidelines on the storage and disposal of hazardous wastes from laboratory operations, contact the departmental lab technician. Hazardous waste management plans generally separate waste into three broad groups (chemical, biohazardous, and radioactive) described separately below.

Workers who generate hazardous waste must be aware that there may be mixed hazards in their waste. For example, animal carcasses containing radioactive material, a hazardous chemical and perhaps an infectious agent would need to be managed according to the considerations and requirements of all three types of hazards defined below. If you will be generating mixed waste, contact the Chemical Hygiene Officer to determine the proper way to handle and manage the material before the waste is generated.

2.10.1 Disposal of Chemical Waste

Chemical waste includes a wide range of materials including discarded chemical products and process wastes. Some chemicals are hazardous because they are specifically listed by the EPA, while others are not listed by the EPA but contain one or more of the EPA's 4 hazardous characteristics: ignitability, corrosivity, reactivity, and toxicity. The following briefly describes the storage and disposal process for chemical waste:

1. Individual generators are responsible for the safe collection and storage of hazardous waste at their site. Satellite waste accumulation areas like this may accumulate as much as 55 gallons of hazardous waste (U-list) or one quart of acutely hazardous waste (P-list) in containers, provided that the container is marked with the words "Hazardous Waste," the hazards of the contents of the container, and identify the contents of the container.

2. Hazardous wastes are segregated into waste streams using waste accumulation records available from the lab technician. Please see Appendix A for assistance in filling out the red and white waste accumulation records.

3. Waste will be picked up monthly from the Satellite Accumulation Area. Only waste located in Satellite Accumulation Areas that has been labeled appropriately, and designated as ready for pickup, will be removed by the Department of Compliance & Enterprise Risk Management, or their designee.

4. Waste stored at the point of origin should be kept to a minimum. Waste will be removed from the central storage area at least every 180 days.

5. No quantity of hazardous chemicals may be transported over public highways without proper packaging, classification, labeling, and documentation. Consequently, hazardous waste will be transported from the College for treatment or disposal only by licensed hazardous waste transporters.

2.10.2 Disposal of Biohazardous Waste

Biohazardous waste describes different types of waste that might include infectious agents. The following briefly describes the storage and disposal process for biohazardous waste. Refer to the Biosafety Manual for further guidance.

A. Animal parts or whole animals should be placed in biohazard waste bags for incineration.

B. If animal tissue is held in liquid preservative, the tissue and liquid preservative should be separated. The animal tissue should be placed in biohazard waste bags for incineration. The preservative should be disposed of as a hazardous waste.

C. Liquid culture waste can be decontaminated using an autoclave. If the material cannot be decontaminated, it should be placed in biohazard waste bags for incineration.

D. Risk Group II and Biosafety Level 2, along with all other medical, pathological, or regulated waste should be placed in biohazardous waste bags for disposal.

2.10.3 Disposal of Radioactive Waste

A. Short-lived RAM Solid Waste

Short-lived RAM solid waste shall be segregated by isotope and placed into a labeled suitably shielded container for decay-in-storage. After the activity decays to background levels as determined by survey with a meter (at least 10 half-lives), the decayed waste may be disposed of as regular trash after all labels denoting radioactivity have been removed.

B. Long-lived RAM Solid Waste

Long-lived RAM solid waste shall be segregated by isotope and placed into a labeled suitably shielded container. Disposal of this low-level radioactive waste will be contracted through a qualified vendor.

C. Short-lived RAM Liquid Waste

Aqueous liquids containing RAM shall be disposed of down a dedicated sink with a large volume of water sufficient to keep the sink drain flushed clean of RAM. The quantity disposed shall not exceed 1 mCi/day and 5 mCi/quarter.

Compliance with NRC release limits is monitored on a college level using RAM inventory and sewer release volume.

Non-aqueous/hazardous chemical liquids containing short-lived RAM (half-life <120 days) must be held until after the activity decays to background levels as determined by survey with a meter (at least 10 half-lives). The decayed waste shall then be disposed of as chemical waste after all labels denoting radioactivity have been removed.

D. Long-lived RAM Liquid Waste

Non-aqueous/hazardous chemical liquids containing long-lived RAM (half-life > 120 days) are known as “mixed” waste. At the present time it is not possible to

dispose of this material. If your research will produce this kind of waste, you should discuss this with the RSO immediately.

E. Preparing Radioactive Waste for Disposal

The user shall provide the following information on each container of radioactive waste:

- Label reading, "Radioactive Waste"
- Authorized User's name
- Generation Date
- Isotope
- Reference Date
- Activity (μCi or mCi)
- Survey Instrument Used
- Chemical Names/Hazards

2.10.4 Disposal of Controlled Substances

The United States Drug Enforcement Agency (DEA) issues permits for controlled substances. The following briefly describes the storage and disposal of controlled substances.

A. All controlled substances must be stored in a safe that is bolted down in a locked cabinet within a locked room.

B. Abandonment of a controlled substance is a violation of the DEA permit under which it is held.

C. Permission to transfer ownership of a controlled substance must be received from the DEA.

D. Controlled substances being held by a licensed individual and to be surrendered for destruction must be inventoried on DEA Form 41 and mailed to the Drug Enforcement Administration.

E. Controlled substances being held by a licensed individual that are lost or stolen must be reported on DEA Form 106 and mailed to the Drug Enforcement Administration. A copy of this form must be sent to the Chemical Hygiene Officer.

2.11 Standard Repair, Transfer, Close-Out, and Transportation Procedures

2.11.1 Repair and Transfer Procedures

Before a request for equipment repair or transfer to another location is initiated, remove chemical contaminants with an appropriate solvent or cleaning solution to ensure the safety of the employees responsible for repair or transfer.

2.11.2 Close-Out Procedures

Whenever a laboratory worker engaged in scientific investigation leaves the College or is transferred to a different location, proper disposition of hazardous materials is required. This includes faculty, staff, and students.

The following procedures should be completed before the responsible individual leaves the College or transfers to a different location on campus:

1. Assure that all containers of chemicals are labeled with the name of the chemical and all known hazards. All containers must be securely closed; empty beakers, flasks, evaporating dishes, etc. should be emptied.
2. Clean chemicals from glassware, assuring proper waste disposal guidelines are followed.
3. Remove regulators from gas cylinders, replace cap, and return cylinders to the supplier. If cylinders are non-returnable, follow disposal procedures.
4. Check refrigerators, freezers, cold rooms, fume hoods, glove boxes, storage cabinets, and bench tops for chemical containers and dispose of items used by the departing researcher. This includes facilities that are shared with other researchers.
5. If chemicals are still usable, transfer the responsibility of the chemical to another laboratory worker who is willing to take charge of the chemical.
6. Remove chemical contaminants from equipment and bench tops with an appropriate solvent or cleaning solution.
7. Label all hazardous waste according to Section 2.10 and notify the lab technician for pick up at least one week prior to vacating the lab.
8. Notify the department when the laboratory or containment area/rooms have been cleared.

2.11.3 Transportation Procedures

A licensed transporter should be contacted to package and deliver materials to a new location on campus. Persons intending to transport chemicals on campus themselves must contact the Chemical Hygiene Officer.

Transportation of chemicals off campus is regulated by federal, state, and local laws. Contact the Chemical Hygiene Officer when chemicals must be transported off campus.

Chemicals shipped off-site must contain a Safety Data Sheet or pre-manufacturing notification form. Contact the Chemical Hygiene Officer for assistance in preparing shipments and PMN forms.

Contact the Chemical Hygiene Officer for guidelines on repair/transfer/transport/close-out involving radioactive materials.

3.0 Hazard Specific Standard Operating Procedures

3.1 Hazard Identification

Identifying the specific hazard associated with a chemical greatly reduces chances of misuse by regular laboratory employees, new users, or visitors to the laboratory. At the

very minimum, hazardous chemical containers must have the chemical name(s) and hazard identification(s). With respect to identifying containers, storage areas and laboratory entranceways, the following conditions entail hazard identification:

A. Laboratory supervisors must ensure that labels on incoming containers of hazardous chemicals for laboratory use are not removed or defaced. Labels contain information on the identity of the chemical(s) in the container and the hazard identification of the chemical(s).

B. Laboratory supervisors must ensure that laboratory containers, those containers filled from the original shipping container, of chemicals are labeled appropriately (see Section 3.3.1).

C. Laboratory supervisors must ensure that employees have access to SDSs. (see Section 6.1.1).

3.2 Chemicals Developed in The Laboratory

The following requirements apply to chemical substances developed in the laboratory:

A. If the composition of the chemical substance which is produced exclusively for the laboratory's use is known, the laboratory supervisor must determine if it is a hazardous chemical. This can be done by a literature search for similar substances. If the chemical is determined to be hazardous, the laboratory supervisor must provide appropriate training to protect employees.
B. If the chemical produced is a product or a by-product whose composition is not known, the laboratory supervisor must assume that the substance is hazardous and must comply with the requirements of the DCCHP.
C. If the chemical is produced for another user outside of the laboratory, the laboratory supervisor must prepare an appropriate SDS or pre-manufacturing notification (PMN) form.

3.3 Labeling

3.3.1 Container Labels

All containers of hazardous chemicals must be labeled with the name of the chemical(s) and the hazard(s), if not provided by the manufacturer. If a chemical has more than one hazard, it must be labeled with all hazards. For example, acetaldehyde is both a flammable and a carcinogen, and must be labeled appropriately. Additionally, these guidelines shall be followed:

A. All peroxide forming chemicals must be labeled with the date upon receipt and upon opening. After the recommended disposal date, usually 3 or 12 months, the chemical shall be tested for peroxides or disposed of properly.

B. Date all explosive or shock-sensitive materials upon receipt and upon opening.

C. As per the Hazard Communication Standard (29 CFR 1910.1200):

   i. Each container of hazardous chemicals in the workplace must be prominently labeled in English with the following information as specified in Appendix C of the OSHA Hazard Communication Standard:

1. Product Identifier
2. Supplier Information
3. Signal Word
4. Pictograms
5. Hazard Statements
6. Precautionary Statements

ii. Anything available over the counter to the general public is exempt from labeling requirements if it has already been labeled by the manufacturer. This includes consumer products such as cans of spray paint or turpentine.

iii. Stationary process containers, such as tanks, may be identified with signs, placards, process sheets, batch tickets or other written materials instead of actually affixing labels to process containers. The sign or placard must convey the same information that a label would and be visible to employees throughout the work shift.

iv. Portable containers into which hazardous chemicals are transferred from labeled containers, and which are intended only for the immediate use of the employee who performs the transfer, are exempt from labeling. However, it is recommended that a temporary label identifying the chemical and its primary hazard be affixed to the container.

v. All sample containers or prepared solutions must be labeled. If there is a large quantity of containers with the same chemical, labeling of the container, tray, cupboard or refrigerator will suffice.

vi. Chemical manufacturers, importers, and distributors of hazardous chemicals are all required to provide appropriate labels and safety data sheets to the employers to which they ship the chemicals. Dickinson College, as a “user” of the chemicals can rely on the information received from its suppliers and has no independent duty to re-label incoming containers; however, they must ensure that the labels have not been removed or defaced.

3.3.2 Waste Containers

All hazardous chemical waste should be segregated and labeled according to Section 2.10. Special attention should be given to the following areas:

A. Waste containers for non-contaminated glass must be labeled (label as "Broken Glass") and kept separate from other non-contaminated waste.

B. Upon initial waste collection, attach a “Hazardous Waste” label containing the accumulation start date.

3.4 Health Hazards

The Laboratory Standard requires that employers, for laboratory uses of substances regulated by OSHA standards, assure that employees' exposures do not exceed the Permissible Exposure Limits (PELs). The PELs represent Time Weighted Averages

(TWA's) in parts per million (ppm) or milligrams of substance per cubic meter of air (mg/m^3). The TWA represents the ratio between exposure and work shift.

3.4.1 Exposure Determination

Employers must contact the Chemical Hygiene Officer to initiate employee exposure monitoring under the following circumstances:

A. Initial monitoring must be performed if there is reason to believe employee exposure levels routinely exceed the action level (or in the absence of an action level, the Permissible Exposure Limit (PEL).

B. Periodic monitoring must be performed when initial monitoring reveals an exposure over the action level (or in the absence of an action level, the PEL). The employer must comply with exposure monitoring provisions of the relevant standard.

C. Monitoring can be terminated in accordance with the relevant standard.

Employers must notify the employee of the monitoring results within 15 working days after receipt of monitoring results. The results must be either individually distributed in writing or posted in a location accessible to all affected employees.

3.4.2 Provisions for Toxic Chemicals

To ensure that employee exposures to toxic chemicals (as defined in Section 1.4) do not exceed the Permissible Exposure Limits (PEL) the following precautions shall be taken:

A. All procedures involving toxic materials shall be conducted in an operating fume hood or other suitable containment device.

B. Personal protective equipment shall be used in accordance with the recommendations given in the related SDS.

C. Immediately after working with toxic materials wash hands and arms.

3.4.3 Provisions for Particularly Hazardous Substances

The Laboratory Standard requires that special precautions for additional employee protection be followed for the laboratory use of particularly hazardous substances (defined in Section 1.4).

The following general hygiene standards should be observed when using particularly hazardous substances. Consult the SDS for specific precautions and procedures.

3.4.3.1 Establish a designated area

A. Use and store materials only in **designated areas**: a restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances. Lab supervisors must assure that all personnel with access are aware of the necessary safety precautions.

B. Label all containers, storage and use areas appropriately. Follow the guidelines established in Sections 3.3.1, 6.1.2 and 6.1.3 of this document.

3.4.3.2 Use proper containment devices

A. Use a fume hood, glove box, or other containment device for procedures which may result in the generation of aerosols or vapors

B. Trap released vapors to prevent their discharge with fume hood exhaust; protect vacuum pumps against contamination with scrubbers or HEPA filters and vent effluent into the hood.

C. It is recommended that breakable containers be stored in chemical-resistant trays. Work and mount apparatus above such trays or cover work and storage surfaces with removable, absorbent, plastic backed paper.

3.4.3.3 Removal of Contaminated Waste

Waste contaminated with particularly hazardous substances shall be segregated from other chemical waste. Contact the lab technician for specific disposal procedures.

3.4.3.4 Follow decontamination procedures prior to leaving the designated area

A. On leaving the designated area, remove protective apparel (place it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck.

B. Thoroughly decontaminate or dispose of contaminated clothing or shoes. If possible, chemically decontaminate by chemical conversion to a less toxic product.

C. Decontaminate vacuum pumps or other contaminated equipment, including glassware, before removing them from the designated area. Decontaminate the designated area before normal work is resumed; vacuum pump oil shall be managed as hazardous waste.

D. Use a wet mop or a vacuum cleaner equipped with a HEPA filter to decontaminate surfaces. DO NOT DRY SWEEP SPILLED POWDERS.

3.4.4 Provisions for Corrosives

Corrosive materials react with the skin, eyes, and mucous membranes causing burns similar to thermal burns. The following standards shall be observed when handling materials that are a corrosive hazard.

A. Containers and equipment used for storage and processing of corrosive materials should be corrosion resistant.

B. Eye protection and rubber gloves shall always be used when handling corrosive materials. A face shield, rubber apron, and rubber boots may also be appropriate, depending on the work performed.

C. ***Never add water to acid.*** When mixing concentrated acids with water, add the acid slowly to water.

D. An eyewash and safety shower must be readily accessible to areas where corrosives are used and stored. See Section 6.2.2 “Safety Equipment" for eyewash and safety shower specifications.

3.4.5 Provisions for Contact Hazards

The following standards shall be observed when handling materials that are a contact hazard:

A. All procedures involving materials that present a contact hazard shall be conducted in an operating fume hood or other suitable containment device.

B. Personal protective equipment shall be used in accordance with the recommendations given in the related SDS.

C. Immediately after working with materials that present a contact hazard wash hands and arms.

3.5 Physical Hazards

Materials, which present a physical hazard (see Section 1.4), can be safely used if the specific hazard(s) are understood. If appropriate precautions are not taken, personal injury or property damage may occur. Additionally, certain chemicals cannot be safely mixed or stored with other chemicals because of the danger of violent reaction or a reaction that generates toxic gas.

3.5.1 Provisions for Fire Hazards

For a fire to occur, three conditions must exist simultaneously: presence of flammable gas in the proper concentration, presence of an oxygen rich environment (usually the air), and a source of ignition. Removal of any one of the three conditions will prevent a fire. The following shall be observed when handling materials that produce a fire hazard.

A. Eliminate ignition sources such as open flames, hot surfaces, sparks from welding or cutting, operation of electrical equipment, and static electricity.

B. Store in NFPA-approved flammable liquid containers or storage cabinets, in an area isolated from ignition sources or in a special storage room designed for flammable materials.

C. Ensure there is proper bonding and grounding when it is required, such as when transferring or dispensing a flammable liquid from a large container or drum. Assure bonding and grounding is checked periodically.

D. All procedures involving flammable materials in excess of 100 milliliters should be carried out in an operational fume hood.

E. Assure appropriate safety equipment (e.g., fire extinguishers, spill kits) is in the area where the procedure will be carried out.

3.5.2 Provisions for Reactive Hazards

The hazard associated with materials classified as reactive is the variable and potentially high rate at which energy may be released under normal conditions, or when struck, vibrated, or otherwise agitated. The following standards shall be observed when handling materials that produce a reactive hazard.

A. Know the reactivity of the materials involved in the experiment or process. Ensure there are no extraneous materials in the area which could become involved in a reaction.

B. Quantities should be limited in the initial experiments to assess the level of energy released and potential control problems. Special reviews should be established to examine operational and safety problems involved before an experiment is scaled up.

C. If the reaction is anticipated to be violent or explosive, use shields or other methods for isolating the materials or the process. Barriers should completely encircle the reaction vessel.

D. Tongs should be used for handling containers of the hazardous material at a safe distance. Remote controls, such as stopcock turners, labjack turners, and remote cable controllers, should be available to avoid exposure of any part of the body to injury.

E. Gloves, such as "electrical" linesman's gloves, shall be worn when it is unavoidably necessary to reach behind a shielded area while an experiment is in progress.

F. Laboratory coats should be worn at all times to reduce minor injuries from flying glass or an explosive flash.

G. A face shield, providing throat protection, shall be worn at all times when a worker is in an exposed position, such as when shields are moved aside, when handling or transporting materials, or when manipulating equipment.

H. Pyrophoric chemicals should be used and stored in inert environments.

I. Some chemicals become increasingly shock-sensitive with age. Contact the Chemical Hygiene Officer when it is suspected that the inadvertent formation of shock-sensitive materials in chemicals being stored has occurred.

J. Do not open any peroxidizable container which has obvious solid formation around the lid or crystals in solution.

K. Addition of an appropriate inhibitor to quench the formation of peroxides is recommended.

L. Store light-sensitive materials in a cool, dark place in amber colored bottles or other containers which reduce or eliminate penetration of light.

M. Follow the same basic handling procedures as for flammable materials.

3.5.3 Provisions for Compressed Gas and Cryogen Hazards

Special systems are needed for handling materials under pressure. Cylinders pose physical and/or health hazards, depending on the compressed gas in the cylinder. The following standards shall be observed when handling materials that produce a compressed gas hazard.

A. Cylinders with regulators must be individually secured. Only cylinders with valve protection caps securely in place may be safely gang-chained.

B. When storing or moving a cylinder, have the valve protection cap securely in place to protect the stem.

C. Cylinders must always be secured in an upright position. Use suitable racks, straps, chains, or stands to support cylinders against an immovable object, such as a bench

or a wall, during use and storage. Do not allow cylinders to fall or lean against one another.

D. Use an appropriate cart to move cylinders.

E. Never bleed a cylinder completely empty. Leave a slight pressure to keep contaminants out.

F. Oil or grease on the high-pressure side of an oxygen cylinder can cause an explosion. Do not lubricate an oxygen regulator or use a fuel gas regulator on an oxygen cylinder. Use an oxygen approved regulator.

G. Always wear goggles or safety glasses with side shields when handling compressed gases.

H. Always use appropriate gauges, fittings, and materials compatible with the gas being handled.

I. When working with a toxic, corrosive, or reactive gas is planned, the SDS should be reviewed for information concerning specific handling requirements. Generally, these gases will need to be used and stored with local exhaust ventilation such as a lab hood or a gas cabinet designed for that purpose.

Liquefied gases that condense oxygen from the air create an oxygen rich atmosphere and increase potential for fire if flammable or combustible materials and a source of ignition are present. Pressure is also a hazard due to the large expansion ratio from liquid to gas, causing pressure build up in containers. Many materials become brittle at extremely low temperatures. Brief contact with materials at extremely low temperatures can cause burns similar to thermal burns. Some of the hazards associated with cryogens are fire, pressure, weakening of materials, and skin or eye burns upon contact with the liquid. The following standards shall be observed when handling materials that produce a liquefied gas (cryogen) hazard:

A. Equipment should be kept clean, especially when working with liquid or gaseous oxygen.

B. Mixtures of gases or fluids should be strictly controlled to prevent formation of flammable or explosive mixtures.

C. Always wear safety glasses with side shields or goggles when handling. If there is a chance of a splash or spray, a full-face shield, an impervious apron or coat, cuffless trousers, and high-topped shoes should be worn. Watches, rings, and other jewelry should not be worn. Gloves should be impervious and sufficiently large to be readily thrown off should a cryogen spill. Potholders could also be used.

D. Containers and systems containing cryogens should have pressure relief mechanisms.

E. Containers and systems should be capable of withstanding extreme cold without becoming brittle.

F. Since glass ampoules can explode when removed from cryogenic storage if not sealed properly, storage of radioactive, toxic, or infectious agents should be placed in plastic cryogenic storage ampoules. Reheat cold materials slowly.

3.6 Radioactive Material Hazards

Use of radioactive materials at Dickinson College is strictly controlled. Contact the Radiation Safety Officer if you plan to use radioactive materials.

3.7 Biological Material Hazards

Use of biological materials at or above Biosafety Level 2 at Dickinson College is strictly controlled. Contact the Chemical Hygiene Officer if you plan to use biological materials at or above Biosafety Level 2. Consult the Dickinson College Biosafety Manual for specific information regarding biological material hazards.

4.0 Substance Specific Standard Operating Procedures

Substance specific standard operating procedures shall be prepared by laboratory supervisors and are required for any lab work involving hazardous substances that fall outside of the Chemical Hygiene Plan's general or hazard specific standard operating procedures. Substance specific standard operating procedures shall be added to the DCCHP to make it lab specific.

The substance specific standard operating procedure must provide the following information:

1. **Identification of the SOP,** including the chemical name, principle researcher's name, lab location, and contact information. Additionally, common synonyms, structures, formulas, CAS numbers, and chemical and physical properties for the chemical should be included.
2. **Process/Procedure,** identifying chemical use.
3. **Potential Hazards,** including both health and physical hazards. Additionally, PEL, TLV, and REL values, routes of exposure, and symptoms of overexposure should be included.
4. **Personal Protective Equipment**. Identify the level required during transportation and use.
5. **Engineering Controls** to be used to prevent or reduce employee exposure, including ventilation, shielding, and containment.
6. **Storage and Handling Requirements** including hygiene practices, incompatibilities, labeling requirements, purchasing limits, and special precautions (refrigeration, dessicator, glove box).
7. **Emergency Procedures,** including firefighting techniques and recommended extinguishing media; first aid procedures for skin and eye contact, ingestion, inhalation; spill control procedures; include location of emergency equipment.
8. **Decontamination Procedures** for equipment (fume hoods, glove boxes, bench tops) and clothing.
9. **Waste Disposal Procedures.**

If the substance is a particularly hazard substance, the following sections must also be included:

10. **Designated Area** where the substance will be used, signs that must be posted warning of the hazard, and how access to the area will be controlled.
11. **Qualified Personnel** who have been trained and may work with the substance.

5.0 Emergency and Medical Procedures

5.1 Basic Steps for Emergency and Spill Response

Releases of hazardous substances that pose a significant threat to health and safety or that, by their very nature, require an emergency response regardless of the circumstances surrounding the release or the mitigating factors are emergency situations. Any one of the following criteria designates an ***emergency situation***:

A. The situation is unclear to the person causing or discovering the spill.

B. The release requires evacuation of persons.

C. The release involves or poses a threat of:

   i. Fire, suspected fire, explosion, or other imminent danger.

   ii. Conditions that are Immediately Dangerous to Life and Health (IDLH) without direct contact.

   iii. High levels of exposure to toxic substances.

   iv. Endangering the environment (e.g., by entering the sewer or soil).

D. The person(s) in the work area is uncertain they can handle the severity of the hazard with the personal protective equipment (PPE) and response equipment that has been provided and/or the exposure limit could easily be exceeded.

Conversely, releases that do not pose significant safety or health hazards to person(s) in the immediate vicinity or to the person(s) cleaning releases, do not have the potential to become emergencies within a short time frame are not emergency situations.

5.1.1 Emergency Situation – Fire

The following steps are basic protocol for handling a fire or fire-related emergency situation in the laboratory:

1. Pull the fire alarm.
2. Evacuate.
3. Do NOT attempt to extinguish a fire unless you have first warned others and/or activated an alarm and are trained to do so.
4. Call 911 from a safe location.
5. Contact Public Safety at x1111 or 717-245-1111 and the Chemical Hygiene Officer at 717-245-1029.

A fire in a small vessel can usually be suffocated by covering the vessel. If the fire is burning over an area too large to be suffocated quickly (within 30 to 45 seconds) and simply, leave the firefighting to those who have been trained and equipped. If you have been trained in the use of fire extinguishers, fight the fire from a position from which you can escape, and only if you are confident that you will be successful. It is easy to underestimate a fire.

5.1.2 Emergency Situation – Spill

If the spill meets the definition of an emergency as described in Section 5.1 above, execute the following:

1. Pull the fire alarm.
2. Call 911 from a safe location.
3. Contact Public Safety at x1111 or 717-245-1111 and the Chemical Hygiene Officer at 717-245-1029.
4. Isolate the spill area and close doors to the room where the spill occurred.
5. Remove ignition sources and shut down equipment.
6. Establish exhaust ventilation to the outside of the building only
7. Evacuate.

5.1.2.1 Attend to victims for a body splash:

1. Remove person(s) from spill area to fresh air only if attempts to rescue victim(s) does not present a danger to the rescuers.
2. Remove contaminated clothing while under an emergency shower.
3. Flood affected area with cold water for at least 15 minutes or longer if pain persists.
4. Wash skin with mild soap and water – do not use neutralizing chemicals, creams, or lotions.
5. Contact emergency response personnel and assure they know the chemical(s) involved.
6. Contact Public Safety at x1111 or 717-245-1111 and the Chemical Hygiene Officer at 717-245-1029.

5.1.2.2 Attend to victims for an eye splash:

1. Remove victim(s) from spill area to fresh air only if attempts to rescue victim(s) does not present a danger to the rescuers.
2. Lead the victim(s) immediately to an emergency eye wash facility.
3. Hold eye lids open.
4. Flush eyes for at least 15 minutes or longer if pain persists.
5. Contact emergency response personnel and assure they know the chemical(s) involved.

6. Contact Public Safety at x1111 or 717-245-1111 and the Chemical Hygiene Officer at 717-245-1029.

5.1.3 Mercury

For very small spills, less than 1 cc, such as a broken thermometer:

1. Use mercury absorb sponges or powder, to pick up mercury droplets.
2. Cover small droplets in inaccessible areas such as cracks with Hg vapor absorbent. Test and repeat if a Hg vapor level remains.
3. Place residue in container for hazardous waste collection.
4. Contact the lab technician for disposal.

For large spills, i.e., greater than 1 cc, contact the Chemical Hygiene Officer for spill cleanup, instructions or assistance.

5.1.4 Biohazardous Spills

A biohazardous spill occurs anytime there is an unplanned release of blood or other potentially infectious material into the work environment. Procedures for biohazardous spills are included in the Dickinson College Exposure Control Plan.

5.1.5 Spill Kits

Ready access to a chemical spill kit is recommended in laboratories that work with hazardous chemicals. Minimally, such a kit should contain:

- Splash resistant goggles
- Chemical resistant gloves
- Plastic bags
- Multi-chemical absorbent (enough for 2-gallon spill)
- Scoop

Most spills greater than 1 liter in volume require assistance from trained personnel.

Some absorbents are chemically specific. The best absorbents are those which can be used to clean up all types of chemical spills. Check absorbents in spill kits for their absorbency range.

Spill kits should be kept in a readily accessible location and each employee should be trained on how to use the spill kit. Please see Appendix D for a full list of chemical spill kit locations.

5.1.6 Non-Emergency Situation – Spill

If the spill does not meet the definition of an emergency as described above, and you have been trained in spill response, cleanup, and disposal, and feel comfortable doing it, execute the following:

1. Locate the appropriate spill kit.
2. Choose the proper protective equipment:
    - Always wear gloves and protective eye wear

- Use additional protective equipment such as an apron, coveralls, or boots as needed. Note: If you need a respirator, you do not have a non-emergency spill and should request outside assistance.

3. Confine or contain the spill.
4. Dispose of spilled materials and disposable personal protective equipment.
5. Restock spill kit and personal protective equipment.

For non-hazardous spills:

1. Cover liquid spills with spill kit absorbent and scoop into a plastic disposal bag.
2. Sweep solid materials into a dustpan and place in a sealed container.
3. Dispose of waste as normal trash as long as substance is non-volatile, non-hazardous.

For hazardous spills:

1. Cover liquid spills with spill kit absorbent and scoop into an appropriate disposal container. As a rule of thumb, the container should be of the same type that the chemical came from. For example, if the spill is from a chemical that was stored in glass bottle, the disposal container should be made of glass.
2. Wet mop or HEPA vacuum dry substances to avoid spreading hazardous dust, provided it is non-water reactive.
3. Contact the lab technician for disposal instructions.

If there are questions about proper spill response techniques, call the Chemical Hygiene Officer at 717-245-1029.

5.2 Injury and Illness

For non-emergency medical treatment, under current Dickinson College policies and procedures, affected employees must seek care from a panel of approved providers. The approved provider list may be obtained by contacting the Office of Human Resources. For emergency treatment, go to the nearest facility and schedule a follow-up treatment with an approved provider. This can best be accomplished at:

UPMC Carlisle

Department of Emergency Medicine

361 Alexander Spring Rd

Carlisle, PA 17015

717-249-1212

In cases where a student is the injured/ill person, and they are **not** student workers (teaching assistants, paid researchers), the Executive Director of the Wellness Center (Health Services, 717-245-1663) should be notified as soon as possible to provide direction and advice on medical management. If Health Services is not accessible, there should be no delay in obtaining medical care at UPMC Carlisle.

In cases where a student worker (paid research, teaching assistants) is the injured/ill person, there should be no delay in obtaining medical care at a Dickinson College Worker's Compensation Panel Provider (Occupational Medicine). If a Panel provider is not available, there should be no delay in obtaining medical care at UPMC Carlisle.

The occupational injury/illness evaluation and follow-up will be provided at no cost to laboratory workers who experience an injury or illness when working in the lab.

The table below summarizes the course of action for each research group:

Researcher Group	**Course of Action**
Student	Wellness Center
Student Employee*	Occupational Medicine
Employee*	Occupational Medicine

*A list of Dickinson College Workers Compensation Panel Providers (Occupational Medicine) is available from Human Resources Services.

If the injury occurs after hours, anyone with an exposure or injury should go to the UPMC Carlisle (361 Alexander Spring Road). If transportation assistance is required, call Public Safety (x1111).

All injuries and illnesses must be reported to your lab supervisor or Human Resources as soon as possible.

If you have any questions regarding injury and illness procedures, contact your laboratory supervisor or the Chemical Hygiene Officer at 717-245-1029.

5.3 Medical Consultations and Examinations

All employees who work with hazardous chemicals shall be provided an opportunity to receive medical attention, including any follow-up examinations which the examining physician determines to be necessary, under the following circumstances:

A. When an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory, the employee shall be provided an opportunity to receive an appropriate examination.

B. Where exposure monitoring reveals an exposure level routinely above the action level (or in the absence of an action level, the PEL) for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements, medical surveillance shall be established for the affected employee as prescribed by the particular standard.

C. Whenever an event takes place in the work area, such as a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure, the affected employee shall be provided an opportunity for a medical consultation. Such consultations shall be for the purpose of determining the need for a medical examination.

All medical consultations and examinations shall be performed by or under the direct supervision of a licensed physician and must be provided without cost to the employee, without loss of pay and at a reasonable time and place.

5.3.1 Information Provided to the Physician

The following information shall be provided to the physician:

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

B. A description of the conditions under which the exposure occurred, including available quantitative exposure data.

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

5.3.2 Physician's Written Opinion

The College shall obtain a written opinion from the examining physician which shall include the following:

A. Any recommendation for further medical follow-up.

B. The results of the medical examination and any associated tests.

C. Any medical condition which may be revealed in the course of the examination which may place the employee at increased risk as a result of exposure to a hazardous workplace.

D. A statement that the employee has been informed by the physician of the results of the consultation or medical examination and any medical condition that may require further examination or treatment.

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

6.0 Standard Laboratory Facility Requirements

6.1 Signs and Information

Labels and warning signs should alert employees to potentially hazardous materials and allow those unfamiliar with the laboratory surroundings to identify hazardous chemical use and storage areas, safety facilities, emergency equipment, exits, and aid emergency response personnel.

6.1.1 Safety Data Sheets (SDS's)

A Safety Data Sheet (SDS) is a document containing chemical hazard identification and safe handling information and is prepared in accordance with the OSHA Hazard Communication Standard. Chemical manufacturers and importers must provide the purchasers of hazardous chemicals an appropriate SDS for each hazardous chemical/product purchased.

The ordering department shall maintain copies of all SDS received. If a chemical is received without an SDS, the ordering department will follow-up with a request to the vendor. If you wish to review a SDS, contact your laboratory supervisor.

If information from an SDS is needed in case of an emergency, call the Department of Public Safety at x1111 or 717-245-1111.

6.1.2 Restricted Access and Designated Areas

Facilities containing certain hazards must have warning signs posted at the designated area of the laboratory where the hazard exists, and at the entranceway to the laboratory. Any areas placarded as such are restricted access, designated areas and have certain standards regarding training and use by employees. Such hazards include:

- Particularly Hazardous Substances
- HIV and HBV research laboratories and production facilities
- Biological agents that require Biosafety Level 2 or higher
- Radioisotopes*

*Please contact the Radiation Safety Officer for requirements on these items.

Other chemical hazards will be dealt with on a case-by-case basis, with consultation from the Chemical Hygiene Officer.

6.1.3 Storage Areas

Chemicals should be stored according to compatibility, as designated by hazard classes. When ordering chemicals that are unfamiliar, review the SDS before purchase so that use and storage guidelines are understood. Assure that the following areas are labeled and chemicals are stored appropriately:

1. Particularly Hazardous Substances
2. Corrosives
3. Flammable/Combustible Liquids
4. Flammable Solids
5. Oxidizers
6. Perchloric Acid
7. Biosafety Level 2 or higher
8. *Radioactives

*Please contact the Radiation Safety Officer for requirements on these items.

6.2 Control Measures

Control measures must be implemented to reduce employee exposure to hazardous chemicals. The three types of control measures are:

A. Administrative Controls: methods of controlling employee exposures to contaminants by job rotation, work assignment, or time periods away from contaminant.

B. Engineering Controls: methods of controlling employee exposures by modifying the source or reducing the quantity of contaminants released into the work environment.

C. Personal Protective Equipment: personal safety equipment designed for secondary employee protection from hazardous chemicals.

NOTE: Engineering controls and administrative controls shall first be determined and implemented when feasible. When such controls are not feasible to achieve full compliance, personal protective equipment or any other protective measures shall be used to keep the exposure of employees within the limits prescribed in the rule.

Use the following primary methods for detecting exposures:

A. Determine the source of exposure.

B. Determine the path the contaminant follows to reach the employee.

C. Determine the employee's work pattern and use of personal protective equipment.

D. Change one or more of the above pathways to reduce or eliminate exposure.

6.2.1 Administrative Controls

The following general control measures are recommended for use in most situations requiring the use of hazardous chemicals:

1. Use training and education as primary administrative controls for reducing exposures.
2. Substitute less harmful chemicals for more harmful chemicals whenever possible.
3. Change or alter processes to minimize exposure.
4. Practice good housekeeping procedures to reduce unnecessary exposures.
5. Isolate or enclose a process or work operation to reduce the number of employees exposed (for example, use a fume hood).
6. Use wet methods to reduce the generation of dust.
7. Use local exhaust ventilation (hoods) at point of generation or dispersion of contaminants and use dilution (general) ventilation to reduce air contaminants.
8. Use special control methods such as shielding and continuous monitoring devices to control exposures in special situations.

6.2.2 Safety Equipment

6.2.2.1 Safety Showers

Safety showers provide an immediate water drench of an affected person. Dickinson College accepts the following ANSI standards for location, design and maintenance of safety showers:

A. Showers shall be located within 10 seconds where injurious corrosive materials are used.

B. Showers must provide a 15-minute water supply at no less than 20 gallons per minute and must provide hands-free operation once activated.

C. The location of the shower should be clearly marked, well lighted and free from obstacles, closed doorways or turns.

Maintenance staff shall test and document the flow through safety showers at least once annually to ensure a flow of 20 gallons per minute. Safety showers are activated quarterly to flush the lines of corrosion and bacterial growth and permit observation of proper pressurization levels and water temperature.

6.2.2.2 Eye Wash Facilities

Dickinson College accepts the following ANSI standards for location, design and maintenance of emergency eyewash facilities:

A. Eyewashes shall be located within 10 seconds where injurious corrosive materials are used.

B. Eye wash facilities must provide the minimum of a 15 minute water supply at no less than 0.4 gallons per minute and must provide hands-free operation once activated.

C. The location of the eyewash should be clearly marked, well lighted and free from obstacles, closed doorways or turns.

Eyewashes are flushed weekly by the Safety & Emergency Management Specialist. A flush consists of activating the eyewash to flush the lines of corrosion and bacterial growth and permit observation of proper pressurization levels and water temperature.

6.2.2.3 Ventilation Controls

Ventilation controls are those controls intended to minimize employee exposure to hazardous chemicals by removing air contaminants from the work site. There are two main types of ventilation controls:

A. General (Dilution) Exhaust: a room or building-wide system, which brings in air from outside and ventilates within. Laboratory air must be continually replaced, preventing the increase of air concentration of toxic substances during the workday. General exhaust systems are not recommended for the use of most hazardous chemicals.

B. Local Exhaust: a ventilated, enclosed workspace intended to capture, contain and exhaust harmful or dangerous fumes, vapors and particulate matter generated by procedures conducted with hazardous chemicals.

Cold rooms and warm rooms have contained recirculated atmospheres. Precautions must be taken to prevent the release of toxic substances into these rooms.

6.2.2.3.1 Provisions for Local Ventilation

To determine ventilation requirements, assess the SDS. Some SDS terminology, as listed below, may indicate a need for special ventilation considerations beyond general exhaust ventilation:

- *use with adequate ventilation*
- *avoid vapor inhalation*
- *use in a fume hood*
- *provide local exhaust ventilation*

Proper Use of Local Ventilation Systems: Once a local ventilation system is installed in a work area, it must be used properly to be effective. For use of hazardous chemicals warranting local ventilation controls, the following guidelines should be observed:

A. Make certain that the hood you are using is appropriate for your work (e.g., Perchloric acid hoods are constructed of stainless steel and have internal wash-down capabilities; biosafety cabinets may be vented into the room and are not designed for chemical use).

B. Conduct all operations which may generate air contaminants at or above the appropriate PEL inside a fume hood.

C. Keep all apparatus at least 6 inches back from the face of the hood and keep the slots in the hood baffle free of obstruction by apparatus or containers. Large equipment should be elevated at least two inches off the base of the fume hood, to allow for the passage of air underneath the apparatus.

D. Do not use the hood as a waste disposal mechanism.

E. Keep extraneous chemicals or apparatus out of the hood, as they will create air flow disturbances. Only materials being used in an ongoing experiment should be kept in the fume hood.

F. Keep paper and other light materials that might be drawn into the vent duct or fan out of the hood.

G. Keep the hood sash completely closed at all times except when the hood is in use.

H. Minimize foot traffic and other forms of potential air disturbances past the face of the hood.

I. Do not have sources of ignition inside the hood when flammable liquids or gases are present.

J. Use sash as a safety shield when boiling liquids or conducting an experiment with reactive chemicals.

K. Make contingency plans in case of power failure or mechanical failure of the hood.

L. Periodically check the airflow in the hood using a continuous monitoring device or another source of visible airflow indicator. If airflow has changed, contact the

Chemical Hygiene Officer to schedule an inspection or Department of Facilities Management for repair.

The system must be checked prior to each use to assure it is operating. **Never work with hazardous chemicals if the required ventilation system is not working**.

6.2.2.3.2 Fume Hood Testing and Repair

The College performs fume hood certifications annually. After an inspection, hoods are passed or failed for use based on the following criteria:

1. The face velocity of air being drawn into the hood at optimal sash height is measured quantitatively in feet per minute (fpm) by an anemometer. One measurement is taken per square foot of face space and averaged. Hoods must have an average face velocity of 80-120 fpm, depending on their design, with 100 fpm being the ideal average face velocity.
2. If the exhaust system does not pass the face velocity test it will be posted as "failed" by the inspector. The laboratory supervisor must contact Facilities Services to have the system repaired before hazardous chemicals can be used in the hood.
3. If the exhaust system does pass, the inspector will post the date of inspection and will mark the hood to indicate proper sash position for optimum hood performance. The hood sash should be set at this point for procedures which could generate toxic aerosols, gases or vapors. In general, the sash height should be set at a level where the operator is shielded to some degree from any explosions or violent reactions which could occur and where optimum air flow dynamics are achieved. If a fume hood has no markings regarding sash height or inspection dates, please contact the Chemical Hygiene Officer to arrange an inspection.

6.2.2.3.3 Spill Kits

Refer to Section 5.1.5.

6.2.3 Personal Protective Equipment

The SDS will provide some information on the personal protective equipment recommended for a given chemical, though the SDS may not provide sufficient information concerning the specific type of safety equipment required (for example, it may say "use gloves" but not list the best glove to use).

6.2.3.1 Eye Protection

Eye protection must be made available to all employees or visitors to laboratories where chemicals are used and stored. The minimum acceptable requirements are for hardened glass or plastic safety spectacles. *The laboratory supervisor should establish the level of eye protection needed per laboratory activity.* American National Standards Institute (ANSI) recommends the following types of eye protection for use in the laboratory:

All eye protective devices must be stamped with "Z87" by the manufacturer if they meet ANSI standards. If the eye protection is not marked, it may not be the most effective protection available.

A. Safety glasses with side shields offer minimal protection against flying fragments, chips, particles, sand and dirt. Safety glasses should be used only when working with solid materials. When a splash hazard exists, other protective eye equipment should be worn.

B. Safety goggles (impact goggles) offer adequate protection against flying particles. These should be worn when working with glassware under reduced or elevated pressure or other similar conditions.

C. Chemical splash goggles (acid goggles) have indirect venting for splash proof sides, which provide adequate protection against splashes. *Chemical splash goggles offer the best eye protection from chemical splashes. Impact goggles should not be worn when danger of a splash exists.*

D. Face shields protect the face and neck from flying particles and splashes. Always wear additional appropriate eye protection under face shields. Ultra-violet light face shields should be worn when working over UV light sources.

6.2.3.2 Protection of Skin and Body

Skin and body protection involves the use of protective clothing to protect individuals from chemical exposure. Use the SDS to determine clothing needed for the chemical being used, as protective garments are not equally effective for every hazardous chemical. Some chemicals will permeate a garment in a very short time, whereas others will not.

The basic and most effective forms of protection are gloves and lab coats.

Avoid wearing open-toed shoes, sandals, shorts, etc. when working with hazardous chemicals. Even when there is minimal danger of skin contact with a particularly hazardous substance, lab coats, coveralls, aprons, or protective suits should be utilized. *These garments should not leave the work site.*

6.2.3.3 Respirators

Use of respirators in laboratories is strongly discouraged. Respirator use is only allowed where engineering controls are not feasible or where they are being installed.

Where the use of respirators is necessary to maintain exposure below permissible exposure limits, refer to the Dickinson College Respiratory Protection Program.

7.0 GLOSSARY

ACGIH – The American Conference of Governmental Industrial Hygienists (ACGIH) is a voluntary membership organization of professional industrial hygiene personnel in governmental or educational institutions. The ACGIH develops and publishes recommended occupational exposure limits each year called Threshold Limit Values (TLV's) for hundreds of chemicals, physical agents, and includes Biological Exposure Indices (BEI).

Action Level – A concentration designated in 29 CFR part 1910 for a specific substance, calculated as an eight-hour time-weighted average, which initiates certain required activities such as exposure monitoring and medical surveillance. The action level is usually half the PEL.

ANSI – The American National Standards Institute (ANSI) is a voluntary membership organization (run with private funding) that develops national consensus standards for a wide variety of devices and procedures. OSHA regulations may "incorporate by reference" an ANSI standard, giving it the force of law, which changes as the standard is updated.

Bonding – A safety practice where the electrical potential between two containers is equalized by interconnecting the containers with clamps and wire to prevent sparks from a static discharge that can ignite flammable materials being transferred between containers.

(**C**) or **Ceiling –** A description usually seen in connection with a published exposure limit. It refers to the concentration that should not be exceeded, even for an instant. It may be written as TLV-C or Threshold Limit Value–Ceiling (See also THRESHOLD LIMIT VALUE).

Chemical Hygiene Officer (CHO) – An employee who is designated by the employer and who is qualified by training and experience, to provide technical guidance in the development and implementation of the provisions of the Chemical Hygiene Plan. This definition is not intended to place limitations on the position description or job classification that the designated individual shall hold within the employer's organizational structure.

Chemical Hygiene Plan (CHP) – A written program developed and implemented by the employer which sets forth procedures, equipment, personal protective equipment, and work practices that are capable of protecting employees from the health hazards presented by the hazardous chemicals used in that particular workplace.

Code of Federal Regulations (CFR) – A collection of the regulations established by law. Title 29 of the CFR, Part 1910.1450 (cited as 29 CFR 1910.1450) is the rule governing "Occupational Exposures to Chemical Substances in Laboratories," better known as the "Laboratory Standard."

Designated Area – An area which may be used for work with "select carcinogens," reproductive toxins, or substances which have a high degree of acute toxicity. This area may be the entire laboratory or an area under a device such as a laboratory hood.

DOT – The United States Department of Transportation (DOT) is the Federal agency that regulates the labeling and transportation of hazardous materials.

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

EPA – The Environmental Protection Agency (EPA) is the governmental agency responsible for administration of laws to control and/or reduce pollution of air, water, and land systems.

Flash Point – The minimum temperature at which a liquid gives off a vapor in sufficient concentration to form an ignitable mixture with air.

Hazard Communication Standard – 29 CFR 1910.1200: Regulation applying to the use of hazardous materials in the workplace, other than laboratories. Cited in the Laboratory Standard as a source of record for definitions of hazardous materials.

Hepatotoxins – Chemicals which produce liver damage.

High Efficiency Particulate Air (HEPA) Filter – Highly effective for the removal of sub-micron size particles. National Sanitation Foundation Standard performance test requires that penetration of dioctylphthalate particles of 0.3 micrometers diameter shall not exceed 0.01 percent.

International Agency for Research on Cancer (IARC) – A division of World Health Organization, Geneva, Switzerland. One of three sources that OSHA refers to for data on a material's carcinogenicity.

Lethal Concentration$_{50}$ (LC_{50}) – The concentration of an air contaminant that will kill 50 percent of the test animals in a group during a single exposure.

Lethal Dose$_{50}$ (LD_{50}) – The dose of a substance or chemical that will kill 50 percent of the test animals in a group within the first 30 days following exposure.

Lower Explosive Limit (LEL) (Also known as Lower Flammable Limit-LFL) **–** The lowest concentration of a gas that will produce a fire or flash when an ignition source (flame, spark, etc.) is present. It is expressed in percent of vapor or gas in the air by volume. Below the LEL or LFL, the air/contaminant mixture is theoretically too "lean" to burn (See also UEL).

Nephrotoxins – Chemicals which produce kidney damage.

Neurotoxins – Chemicals which produce toxic effects on the nervous system.

NFPA – The National Fire Protection Association (NFPA) is a voluntary membership organization whose aims are to promote and improve fire protection and prevention. NFPA has published 16 volumes of codes known as the National Fire Codes. Within these codes is Standard No. 704, "Identification of the Fire Hazards of Materials." This is a system that rates the hazard of a material during a fire. These hazards are divided into health, flammability, and reactivity hazards and appear in a well-known diamond system using from zero through four to indicate severity of the hazard. Zero indicates no special hazard and four indicates severe hazard. Many NFPA standards are incorporated into law by reference.

NIOSH – The National Institute for Occupational Safety and Health (NIOSH) is a Federal agency that among its various responsibilities trains occupational health and safety professionals, conducts research on health and safety concerns, and tests and certifies respirators for workplace use.

National Toxicology Program (NTP) – A federal program overseen by the Department of Health and Human Services with resources from the National Institutes of Health, the Food and Drug Administration, and the Center for Disease Control. One of three sources that OSHA refers to for data on a material's carcinogenicity.

Occupational Safety and Health Administration (OSHA) – A Federal agency under the Department of Labor that publishes and enforces safety and health regulations for most businesses and industries in the United States.

Permissible Exposure Limit (PEL) – An exposure limit that is published and enforced by OSHA as a legal standard. PEL may be either a time-weighted-average (TWA) exposure limit (8 hour), a 15-minute short term exposure limit (STEL), or a ceiling (C).

The PELs are found in Tables Z-1, Z-2, or Z-3 of OSHA regulations 1910.1000. (See also TLV).

Personal Protective Equipment (PPE) – Any devices or clothing worn by the worker to protect against hazards in the environment. Examples are respirators, gloves, and chemical splash goggles.

Recommended Exposure Limit – The highest allowable airborne concentration that is not expected to injure a worker, as determined by NIOSH. It may be expressed as a ceiling limit or as a time-weighted average, usually for 10-hour shifts.

Reproductive Toxins – Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses.

Safety Data Sheet (SDS) – As part of OSHA's Hazard Communication Standard (29 CFR 1910.1200) better known as worker right-to-know law, manufacturers and distributors are required to provide these data sheets which communicate to the end user the hazards a material presents.

Short Term Exposure Limit (STEL) – Represented as STEL or TLV-STEL, this is the maximum concentration to which workers can be exposed for a short period of time (15 minutes) for only four times throughout the day with at least one hour between exposures. Also, the daily TLV-TWA must not be exceeded.

"Skin" – This designation sometimes appears alongside a TLV or PEL. It refers to the possibility of absorption of the particular chemical through the skin and eyes. Thus, protection of large surface areas of skin should be considered to prevent skin absorption so that the TLV is not invalidated.

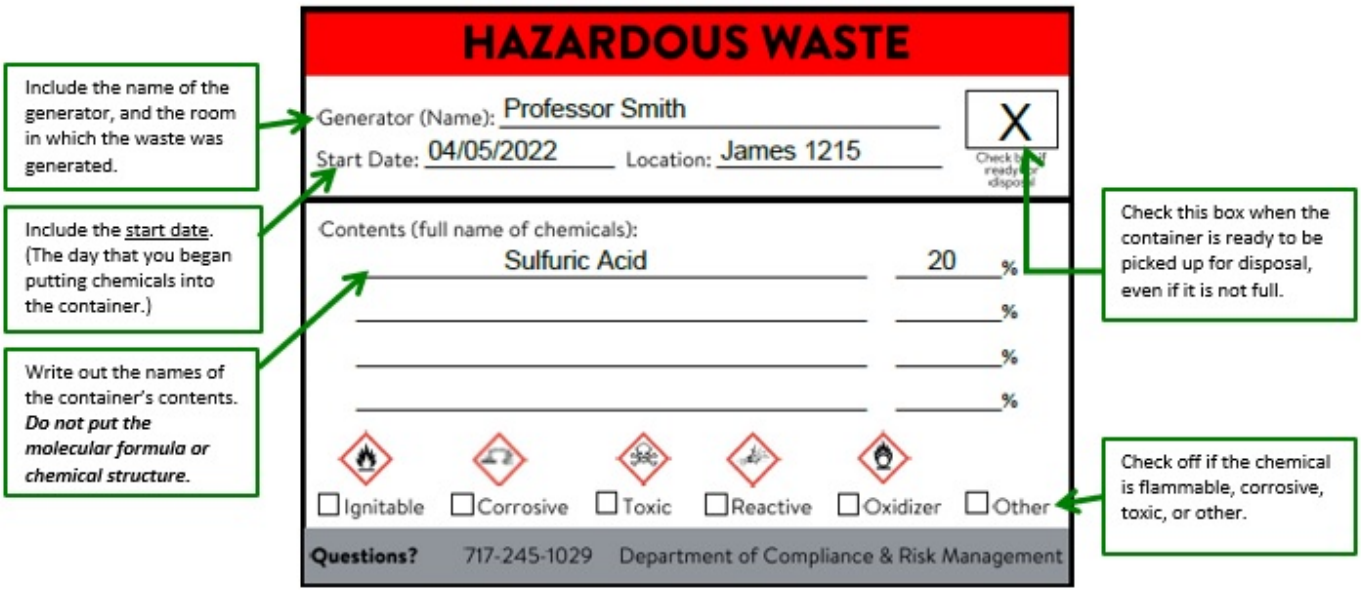
Teratogen – An agent or substance that may cause physical defects in the developing embryo or fetus when a pregnant female is exposed to that substance.

Threshold Limit Value (TLV) – Airborne concentrations of substances devised by the ACGIH that represents conditions under which it is believed that nearly all workers may be exposed day after day with no adverse effect. TLV's are advisory exposure guidelines, not legal standards, which are based on evidence from industrial experience, animal studies, or human studies when they exist. There are three different types of TLV's: Time Weighted Average (TLV-TWA), Short Term Exposure Limit (TLV-STEL), and Ceiling (TLV-C) (See also PEL).

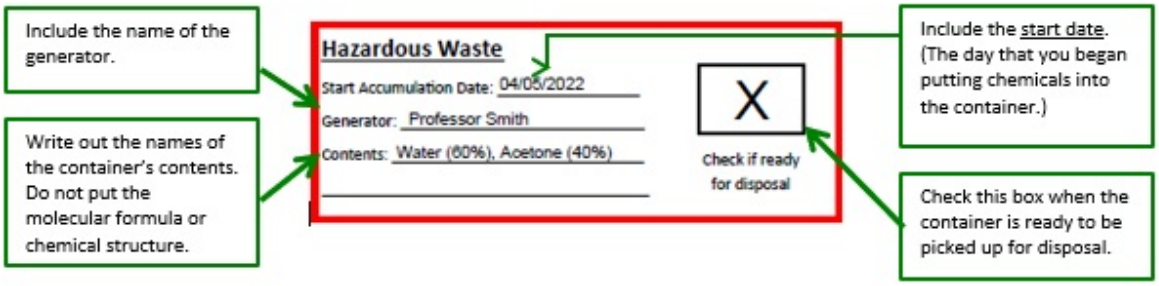
Time Weighted Average (TWA) – The average time, over a given work period (e.g., 8-hour workday) of a person's exposure to a chemical or an agent. The average is determined by sampling for the contaminant throughout the time period. Represented as TLV-TWA.

Upper Explosive Limit (UEL) – Also known as Upper Flammable Limit (UFL), is the highest concentration (expressed in percent of vapor or gas in the air by volume) of a substance that will burn or explode when an ignition source is present. Theoretically, above this limit the mixture is said to be too "rich" to support combustion. The difference between the LEL and the UEL constitutes the flammable range or explosive range of a substance. That is, if the LEL is 1ppm and the UEL is 5ppm, then the explosive range of the chemical is 1ppm to 5ppm (See also LEL).

Appendix A: How to Fill out Hazardous Waste Label



There are two different sizes of hazardous waste labels. The small waste labels (below) should be used when the larger size is too big to fit on the chemical container.



Appendix B: Guidelines for Use of Peroxide-Forming Chemicals

Many laboratory chemicals are prone to the formation of explosive peroxides under normal usage. Opinions vary regarding the level at which peroxide formation poses a risk: while a maximum concentration of 100 ppm is widely accepted among industrial hygienists, OSHA has no published guidelines for the storage, use, and disposal of peroxidizable chemicals. To ensure the safety of Dickinson College employees, the following guidelines have been established with regards to peroxide forming chemicals.

Purchase

Peroxidizable compounds should be purchased in quantities, which can be exhausted within the time indicated in Table A. Container sizes should be selected according to use requirements so that exposure to air is minimized through reduced container openings.

Table A: Safe Storage Period for Peroxide Forming Chemicals

Description	Safe Storage Period
Unopened chemicals from manufacturer	18 months
Opened Containers	
Chemicals in List A	3 months
Chemicals in List B and D	12 months
Uninhibited Chemicals in List C	24 hours
Inhibited Chemicals in List C	12 months

Labeling

All peroxidizable materials in Lists A-D must have a label containing the date received from the manufacturer and the date opened. Additionally, labels must state, "PEROXIDIZABLE COMPOUND: DISCARD OR TEST WITHIN **XX** MONTHS AFTER OPENING," where **XX** is the safe storage period from Table A. Labels should be in red print on a white background.

Storage

All peroxidizable compounds should be stored away from heat and light. All containers must have tight closures to prevent air exposure, evaporation and concentration of peroxides.

Safe Handling

Test for peroxides before distilling or evaporating any List A or B material. Before distilling any List C material, a suitable polymerization inhibitor must be added. During distillation, addition of a high molecular weight inerting solvent, such as mineral oil or a phthalate ester will dilute residual peroxides when distillation is complete. Should such a diluent be undesirable, distill to not less than 10%. NEVER distill to a dry residue.

Safety glasses and a face shield should be used when evaporating or distilling mixtures that contain peroxidizable compounds.

Disposal

All peroxidizable compounds from Lists A-D will be removed from laboratories for disposal after the safe storage period expires. This includes unopened chemicals after 18 months of storage.

All peroxidizable compounds suspected of having high peroxide levels, because of visual observation of unusual viscosity or crystal formation, or because of age, should be considered extremely dangerous. DO NOT attempt to open these containers as peroxide crystals around the container cap could detonate. Contact the Compliance & Enterprise Risk Management Office at 717-245-1029 for assistance.

References

1. Recognition and Handling of Peroxidizable Compounds; Data Sheet 655; National Safety Council: Chicago, Il, 1987.
2. Kelly, Richard J., Review of Safety Guidelines for Peroxidizable Organic Chemicals, Chemical Health & Safety, American Chemical Society, Sept/Oct. 1996.
3. Furr, Keith Handbook of Lab Safety, 4th ed., CRC Press, 1995.

Classes of Peroxidizable Chemicals

List A: Chemicals that form explosive peroxides without concentration

Butadiene (liquid monomer)	Isopropyl ether
Chloroprene (liquid monomer)	Tetrafluoroethylene (liquid monomer)
Divinylacetylene	Vinylidene chloride

List B: Chemicals that form explosive peroxides on concentration

Acetal	2-Hexanol
Acetaldehyde	Methylacetylene
Benzyl alcohol	3-methyl-1-butanol
2-Butanol	Methylcyclopentane
Cumene	Methyl isobutyl ketone
Cyclohexanol	4-methyl-2-pentanol
2-Cyclohexen-1-ol	2-Penten-1-ol
Cyclohexene	4-Penten-1-ol
Decahydronaphthalene	1-Phenylethanol
Diacetylene	2-Phenylethanol
Dicyclopentadiene	Tetrahydrofuran

Diethyl ether	Tetrahydronaphthalene
Diethylene glycol dimethyl ether (diglyme)	Vinyl ethers
Dioxanes	Other Secondary Alcohols
Ethylene glycol dimethyl ether (glyme)	
4-Heptanol	

List C: Chemicals that may autopolymerize as a result of peroxide accumulation

Acrylic acid[1]	Tetrafluoroethylene
Acrylonitrile[1]	Vinyl acetate
Butadiene	Vinylacetylene
Chloroprene	Vinyl chloride
Chlorotrifluoroethylene	Vinylpyridine
Methyl methacrylate[1]	Vinyladiene chloride
Styrene	

[1] Although these chemicals form peroxides, there are no reported explosions.

List D: Chemicals that may form peroxides but cannot clearly be placed in List A-C.

Acrolein	1,2-Epoxy-3-isopropoxypropane[2]
Allyl ether[2]	1,2-Epoxy-3-phenoxypropane
Allyl ethyl ether	Ethoxyacetophenone
Allyl phenyl ether	1-(2-Ethoxyethoxy)ethyl acetate
p-(n-Amyloxy)benzoyl chloride	2-Ethoxyethyl acetate
n-Amyl ether	(2-ethoxyethyl)-o-benzoylbenzoate
Benzyl n-butyl ether	1-Ethoxynaphthalene
Benzyl ether	Ethoxyphenyl isocyanate
Benzyl ethyl ether	1-ethoxy-2-propyne
Benzyl methyl ether	3-ethoxyopropionitrile
Benzyl 1-naphthyl ether[2]	2-ethylacrylaldehyde oxime
1,2-Bis(2-chloroethoxy)ethane	2-ethylbutanol
Bis(2-ethoxyethyl) ether	Ethyl ethoxypropionate
Bis(2-methoxyethoxy)ethyl) ether	2-ethyl hexanal
Bis(2-chloroethyl) ether	Ethyl vinyl ether
Bis(2-ethoxyethyl) adipate	Furan p-phenylphenetone

Bis(2-ethoxyethyl) phthalate	2,5-hexadiyn-1-ol
Bis(2-methoxyethyl) carbonate	4,5-hexadien-2-yn-1-ol
Bis(2-methoxyethyl) ether	n-hexyl ether
Bis(2-methoxyethyl) phthalate	Iodophenetole
Bis(2-methoxymethyl) adipate	Isoamyl ether[2]
Bis(2-n-butoxyethyl) phthalate	Isobutyl vinyl ether
Bis(2-phenoxyethyl) ether	Isophorone[2]
Bis(4-chlorobutyl) ether	p-isopropoxypropionitrile[2]
Bis(chloromethyl) ether	Isopropyl 2,4,5-trichlorophenoxyacetate
2-bromomethyl ethyl ether	Limonene
Bromophenetole	1,5-p-methadiene
3-bromopropyl phenyl ether	Methyl p-(n-amyloxy)benzoate
1,3-butadiyne	4-methyl-2-pentanone
Buten-3-yne	n-methylphenetole
Tert-butyl ethyl ether	2-methyltetrahydrofuran
Tert-butyl methyl ether	3-methoxy-1-butyl acetate
n-butyl phenyl ether	2-methoxyethanol
n-butyl vinyl ether	3-methoxyethyl acetate
Chloroacetaldehyde diethylacetal[2]	2-methoxyethyl vinyl ether
2-chlorobutadiene	Methoxy-1,3,5,7-cyclooctatetraene
1-(2-chloroethoxy)-2-phenoxyethane	Methoxypropionitrile
Chloroethylene	m-Nitrophenentole
Chloromethyl methyl ether	1-Octene
Chlorophenetole	Oxybis(2-ethyl acetate)
Cyclooctene[2]	Oxybis(2-ethyl benzoate)
Cylcopropyl methyl ether	Oxydipropionitrile
Diallyl ether[2]	1-Pentene
p-Di-n-butoxybenzene	Phenoxyacetyl chloride
1,2-dibenzyloxyethane[2]	Phenoxypropionyl chloride
p-Dibenzyloxybenze[2]	Phenyl o-propyl ether
1,2-dichloroethyl ethyl ether	n-propyl ether

2,4-dichlorophenetole	n-propyl isopropyl ether
Diethoxymethane[2]	Sodium 8,11,14-eicosatetraenoate
2,2-Diethoxypropane	Sodium ethoxyacetylide
Diethylethoxymethylenemalonate	Tetrahydropyran
Diethyl fumarate	Triethylene glycol diacetate
Diethyl acetal[2]	Triethylene glycol diproprionate
Diethylketene	1,3,3-trimethoxypropene[2]
Diethoxybenzene	1,1,2,3-tetrachloro-1,3-butadiene
1,2-Diethoxyethane	4-vinyl cyclohexene
Dimethoxymethane[2]	Vinylenecarbonate
1,1-Dimethoxyethane[2]	Vinylidene chloride[2]
Dimethylketene	
3,3-Dimethoxypropene	
2,4-Dinitrophenetole	
1,3-Dioxepane[2]	
Di(1-propynyl) ether	
Di(2-propynyl) ether	
Di-n-propoxymethane[2]	

[2] These chemicals easily form peroxides and should probably be considered under List B

Appendix C: TSCA Research Exempt Substances Notification Form

Purpose

Dickinson College is committed to operating academic programs in the safest manner possible, with concern for the individual and the protection of the environment in accordance with all applicable Federal and State statutes. This TSCA PMN notification Protocol for research generated chemicals and substances has been prepared as a companion to the Dickinson College Chemical Hygiene Plan. This supplemental document outlines regulations for handling research generated chemical and substances that are shipped or transported to an off-site location in accordance with the United States Environmental Protection Agency (US EPA) regulations.

Authority

Title 40 CFR 720-723, *Standards for TSCA Research Exempt Chemical Substances*.

Applicability

Section 5(h) of TSCA, 15 USC 2604(h) provides certain exemptions from the section 5(a) Premanufacture Notice (PMN) and significant new use notice requirements. Section 5(h)(1) authorized EPA to allow persons, upon application, to manufacture or process a new chemical substance or a chemical substance subject to a significant new use rule for "test marketing" purposes without complying with section 5(a). Section 5(h)(3) exempts substances that are manufactured in **small quantities** solely for research and development (R&D) from the section 5(a) notice requirements. No application is required for the exemption for R&D under section 5(h)(3) however recordkeeping requirements do apply.

Any manufacturer, importer or individual who distributes a chemical substance to persons not in its employ must notify those persons in written form of:

- Substances are to be used only for R&D purposes
- Notice of health or environmental risks
- Must use a container labeling system

Recordkeeping requirements to comply with the TSCA PMN R&D exemption require that the College maintain copies of all information on that specific chemical, its hazards, and method of risk notification to the person or persons receiving the chemical substance. An alternative recordkeeping method is to document all laboratory prudent practices in accordance with 40 CFR720.78(b)(iii). Additional recordkeeping requirements include maintaining the names and addresses of those who received a particular substance, identity of the substance, the amount distributed, and copies of written notification.

Definitions

Small quantity (solely for R&D) – Quantity of a chemical substance manufactured, imported or processed or proposed to be manufactured, imported or processed solely for research and development that are not greater than reasonably necessary for such purposes.

Technically qualified individual – Means a person or persons who, because of education, training or experience, or a combination of these factors is capable of understanding the health and

environmental risks associated with the chemical substance, which is used under his or her supervision, and who is responsible for enforcing appropriate methods of conducting scientific research to minimize such risks, and who is responsible for the safety assessments and clearances related to the procurement, storage, use and disposal of the chemical substance as may be appropriate or required within the scope of conducting a research and development activity.

Research and Development – Activities that are intended solely as scientific experimentation, research or analysis, and can include the synthesis of new chemical substances or the analysis, experimentation or research on new or existing chemical substances.

Shipping Label (placed on the outside of outgoing packages)

NOTICE: This package contains

TSCA Research Exempt Chemical Substances

(For R&D Use only)

Read the enclosed "Notification Form"

Use prudent laboratory practices for handling chemical substances of unknown toxicity.

TSCA Sample Label (placed on each individual sample container)

For R&D Use ONLY

Dickinson College

TSCA

Research Exempt Substances Notification

(Toxic Substances Control Act 40CFR720-723)

P.O. Box 1773, Carlisle, PA 17013

717-245-1029

Attention Chemical Recipient: This sample is being sent to you under the TOXIC SUBSTANCE CONTROL ACT (TSCA) RESEARCH EXEMPT SUBSTANCE NOTIFICATIONS RULE. This sample is to be used for research and development, testing and evaluation purposes only.

Regulatory Guidance: 40 CFR 720-723 & EPA Office of Toxic Substances "New Chemical Information Bulletin, Exemptions for Research and Development and Test Marketing."

In lieu of a Safety Data Sheet (SDS), the following information on this sample(s) is being provided.

Section #1

Sample #	Amount Wt/Vol.	Form (Solid/Liquid/Gas)	Common Description *

* Common Description, i.e., organic hydrocarbon, organometallic, inorganic salt, DNA, RNA etc.

Section #2

List any known (or reasonably anticipated) health or environmental hazards and required precautions and any known EPA Rules or Orders issued regarding this substance.

Sample #	Hazards: *i.e.*, flammable, poison, oxidizer, non-hazardous, etc.

This sample(s) should be returned to sender or disposed of in accordance with State, Federal and Local Regulations.

Section #3

THE RECIPIENT MUST RETAIN THIS FORM ON FILE

Recipient's Name (please print) _____ Telephone Number _____

Mailing Address _____ City _____ State _____

Sender's Name (please print) _____ Department _____ PI _____

Sender's Signature _____ Telephone _____ Date _____

For Office Use Only:

Approved By: _____ Date: _____ Carrier (Fed Ex, UPS, etc)

TSCA MANAGER

SHIPPING INSTRUCTIONS FOR TSCA RESEARCH & DEVELOPMENT CHEMICALS

FROM DICKINSON COLLEGE

In accordance with TSCA (Toxic Substances Control Act) 40 CFR 720-723, state and federal rules apply to the shipping and transporting of chemical substances. Researchers are exempt from these notification rules if your chemical substance or mixture containing your chemical substance is not sold or used for any commercial purpose and is considered "small quantity" [defined by 40CFR 720.3 (cc)]. This sample can only be shipped for analysis, experimentation or testing related to Research & Development (R&D).

The following procedures apply for shipping all chemical substances from Dickinson College. A trained member of your department staff will facilitate your packaging and reporting requirements as outlined by 40CFR720-723.

The Director of Compliance & Enterprise Risk Management will be responsible for training and oversight of the TSCA program.

❑1. Before the sample is packaged, complete ***Section #1*** of the **"TSCA Research Exempt Substances Notification Form."** All parts must be filled out to the best of your knowledge before continuing, use N/A if a section in "Not Applicable." **DO NOT** leave any line blank!

❑2. In ***Section #2*** you are required to evaluate the health & environmental risks associated with exposure to your chemical substance (40 CFR 720.36(b)) and notify the receiver of your chemical substance of any known or reasonably anticipated risks to their health or to the environment that exposure to your chemical substance may cause (40 CFR 720.36(a)(2), 40 CFR 720.36(b)(2), and 40 CFR 720.36(c)). This Section **MUST** be completed fully.

❑3. ***Section #3*** must also be filled out completely. Please print all data except for the sender's signature.

❑4. A trained facilitator of the Dickinson College TSCA program must check the completed form.

❑5. Each individual sample must have a **"For R&D Use Only"** sticker applied to it.

❑6. Package the sample in accordance with DOT packaging requirements.

❑7. Place a signed COPY *(Both a "Senders Signature" and an "Approved by" Signature)* of the **"TSCA Research Exempt Substances Notification Form"** in the package with your sample.

❑8. The Dickinson College trained facilitator will double check all paperwork and packaging; then they will seal the package in accordance with DOT packaging requirements.

❑9. After the address label is placed on the outside of the package, the Dickinson College trained facilitator will place the "TSCA Shipping Label" on the outside of the package beside the regular shipping label.

❑10. The ORIGINAL **"TSCA Research Exempt Substances Notification Form"** will be filed in the TSCA notebook in the Department of Compliance & Enterprise Risk Management. These records will be archived for a minimum of 5 years.

Appendix D: Chemical Spill Kit Locations

Science Department Locations:

Stuart Hall:

1105, 1118, 1121, 1122, 2105, 2112, 2117, 2118

James Hall:

B211, B240, 1255, 1228

Rector North:

1316

Kaufman Hall:

116B, 134B

Art Department Locations:

Weiss:

Printmaking Studio Room 340

Goodyear:

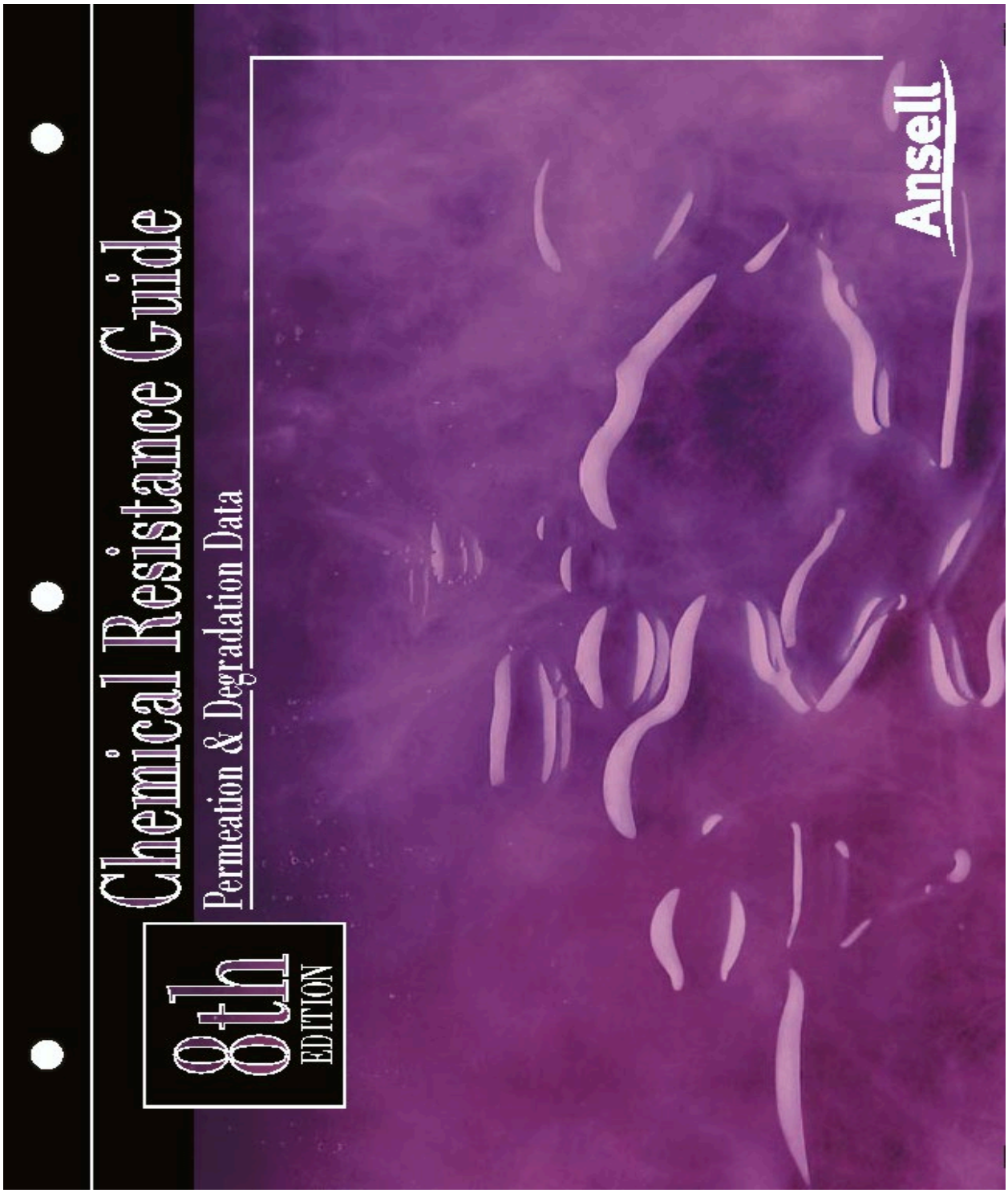
Outside Studio 6 (Main floor near flammable storage cabinet)

Appendix E: Laboratory Safety Checklist

Dickinson College			
Laboratory Safety Checklist			
Fire/Life Safety	**Yes**	**No**	**N/A**
Are eyewashes, emergency showers, and fire extinguishers kept accessible and unobstructed?			
Is an emergency eyewash station operational, inspected, and flushed weekly?			
Has all PPE been restocked and stored appropriately?			
Housekeeping and Egress	**Yes**	**No**	**N/A**
Are egress pathways kept unobstructed and free from trip hazards?			
Are working surfaces and equipment (including balances) kept clean and free of chemical residues?			
Are glass and other "sharps" properly stored, or disposed of in puncture resistant containers?			
Is laboratory equipment properly stored and safeguarded (i.e., put in designated location, unplugged, turned off, electrical, etc.)?			
Chemical Storage	**Yes**	**No**	**N/A**
Are all flammable, corrosive, toxic, or reactive chemicals stored by compatibility and in approved chemical storage cabinets or designated locations?			
Are all stored chemical containers kept closed, not leaking, and in good condition?			
Are all containers (including secondary lab containers) labeled to identify the contents and any applicable hazard warnings?			

Are flammable liquids that require refrigeration stored in approved refrigerators or freezers?			
Hazardous Waste Storage	**Yes**	**No**	**N/A**
Are all waste containers labeled with a "Hazardous Waste" label that is filled out completely, lists each of the chemical constituents that are contained in the bottle, and the hazards of the contents?			
Do all waste containers have the funnels removed, and are kept closed?			
Are hazardous wastes stored away from drains or stored in secondary containment?			
Fume Hood	**Yes**	**No**	**N/A**
Is the sash closed?			
Are containers in fume hood kept closed?			
Are chemicals that are no longer going to be used removed from the fume hood for proper storage?			
Have items stored in the back part of the fume hood which could be blocking the airflow been moved away from the back, or removed from the fume hood?			

Appendix F: Glove Selection Guide



Permeation/Degradation Resistance Guide for Ansell Chemical Resistant Gloves

Introduction to the 8th Edition

When reviewing the following recommendations, remember that tests are conducted under laboratory conditions, and that actual workplace conditions usually dictate a *combination* of performance capabilities. A product's resistance to cuts, punctures, and abrasion must also be taken into account as a critical usage factor. A glove with excellent permeation resistance may not be adequate if it tears or punctures easily. Always factor in the physical performance requirements of the job or application when selecting a chemical-resistant glove.

Ansell's ASTM standard permeation and degradation tests are presented on the following pages as an aid in determining the general suitability of various products for use with specific chemicals. Because the conditions of ultimate use are beyond our control, and because we cannot run permeation tests in all possible work environments and across all combinations of chemicals and solutions, these recommendations are advisory only. THE SUITABILITY OF THE PRODUCT FOR A SPECIFIC JOB MUST BE DETERMINED BY TESTING BY THE PURCHASER.

Definition of Key Terms

Permeation is a process by which a chemical can pass through a protective film without going through pinholes, pores, or other visible openings. Individual molecules of the chemical enter the film, and "squirm" through by passing between the molecules of the glove compound or film. In many cases the permeated material may appear unchanged to the human eye.

Chemical permeation can be described in simple terms by comparing it to what happens to the air in a balloon after several hours. Although there are no holes or defects, and the balloon is tightly sealed, the air gradually passes through (permeates) its walls and escapes. This simple example uses gas permeation, but the principle is the same with liquids or chemicals.

Permeation data are presented in two values: Breakthrough time and Rate. Breakthrough times (min.) are the times observed from the start of the test to first detection of the chemical on the other side of the sample (for test methodology, see the outside back cover of this guide). These times represent how long a glove can be expected to provide effective permeation resistance when totally immersed in the test chemical.

Permeation rates are the highest *flow rates* recorded for the permeating chemicals through the glove samples during a six-hour or eight-hour test. These qualitative ratings are comparisons of permeation rates to each other.

Degradation is a reduction in one or more physical properties of a glove material due to contact with a chemical. Certain glove materials may become hard, stiff, or brittle, or they may grow softer, weaker, and swell to several times their original size. If a chemical has a significant impact on the physical properties of a glove material, its permeation resistance is quickly impaired. For this reason, glove/chemical combinations rated "Poor" are usually not tested for permeation resistance, and combinations rated "Not Recommended" are never tested for permeation resistance. Please note, however, that permeation and degradation do not always correlate.

The overall Degradation Rating for each chemical is explained in "How To Read The Charts."

How to Read the Charts

Three categories of data are represented for each Ansell product and corresponding chemical: 1) overall degradation resistance rating; 2) permeation breakthrough time, and 3) permeation rate.

Standards for Color-Coding

A glove-chemical combination receives GREEN if either set of the following conditions is met:

- The Degradation Rating is Excellent or Good
- The Permeation Breakthrough Time is 30 minutes or greater
- The Permeation Rate is Excellent, Very Good, or Good

OR

- The Permeation Rating is not specified
- The Permeation Breakthrough Time is 240 minutes or greater
- The Degradation Rating is Excellent, or Good

A glove-chemical combination receives RED if either set of the following conditions is met:

- The Degradation Rating is Poor or Not Recommended

OR

- The Degradation Rating is Degrades with Delamination (DD)
- The Permeation Breakthrough Time is less than 20 minutes

All other glove-chemical combinations receive YELLOW. In other words, any glove-chemical combination not meeting either set of conditions required for Green, and not having a Red degradation rating of either Poor or Not Recommended, receives a YELLOW rating.

Why is a product with a shorter breakthrough time sometimes given a better rating than one with a longer breakthrough time?

One glove has a breakthrough time of just 4 minutes. It is rated "very good," while another with a breakthrough time of 30 minutes is rated only "fair." Why? The reason is simple: in some cases the rate is more significant than the time.

Imagine connecting two hoses of the same length but different diameters to a faucet using a "Y" connector. When you turn on the water, what happens? Water goes through the smaller hose first because there is less space inside that needs to be filled. But when the water finally gets through the larger hose it really gushes out. In only a few minutes, the larger hose will discharge much more water than the smaller one, even though the smaller one started first.

The situation is similar with gloves. A combination of a short breakthrough time and a low permeation rate may expose a glove wearer to less chemical than a combination of a longer breakthrough time and a much higher breakthrough rate, if the glove is worn long enough.

Key to Permeation Breakthrough

> Greater than n (time) <Less than (time)

Key to Degradation Ratings

E–Excellent; fluid has very little degrading effect.
G–Good; fluid has minor degrading effect.
F–Fair; fluid has moderate degrading effect.
P–Poor; fluid has pronounced degrading effect.
DD–Degrades the outer layer and delaminates it.
NR–Not Recommended; fluid has severe degrading effect.

DD is a new degradation rating that applies to Viton/butyl gloves versus certain chemicals. It means "Degrades and Delaminates". If a chemical causes severe swelling of Viton but has little effect on butyl, the adhesion between these two rubber layers can be overcome under the relatively severe continuous liquid contact that is part of an ASTM or CEN standard permeation test. The end result of this stress is Viton "blisters" or even complete layer separation. The damage is likely to be permanent.

In cases such as these the butyl layer is providing most of the protection. But if the end use involves only the possibility of splash or intermittent contact so that the Viton layer never absorbs enough chemical to swell and delaminate, Viton/butyl gloves might still be the best choice. The ultimate decision on when to use plain butyl and when to use Viton/butyl will depend on the overall chemical mix in your facility and on the degree of exposure to each.

Specific Gloves Used for Testing

Degradation and Permeation	
Laminated LCP™ Film	Barrier® 2.100 (2.5 mil/0.06 mm)
Nitrile	SoloVex® 37-165 (22 mil/0.56 mm)
Neoprene Unsupported	29-865 (18 mil/0.46 mm)
Polyvinyl Alcohol Supported	PVA™
Polyvinyl Chloride Supported	Snorkel®
Natural Rubber Latex	Canners 3-43 (20 mil/0.51 mm)
Neoprene/Latex Blend	ChemTek® 22-4 (27 mil/0.68 mm)
Butyl Unsupported	ChemTek® 38-320 (20 mil/0.51 mm)
Viton/Butyl Unsupported	ChemTek® 38-612 (12 mil/0.30 mm)

Methodology
PERMEATION TEST CELL
Permeation Testing
Ansell conducts permeation testing in accordance with ASTM Method F 739 standards. A specimen is cut from the glove and clamped into a test cell as a barrier membrane (see illustration). The "exterior" side of the specimen is exposed to a hazardous chemical. At timed intervals, the unexposed "interior" side of the test cell is checked for the presence of the permeated chemical and the extent to which it may have permeated the glove material.
This standard allows a variety of options in analytical technique and collection media. At Ansell, dry nitrogen is the most common medium and gas chromatography with FID detection is the most common analytical technique. Our Research Department also uses liquids such as distilled water and hexane as collecting media, and techniques such as conductivity, colorimetry, and liquid chromatography for analysis of the collecting liquid.
Degradation Testing
Patches of the test material are cut from the product. These patches are weighed and measured, and then completely immersed in the test chemical for 30 minutes. The percentage of change in size is determined, and the patches are then dried to calculate the percentage of weight change. Observed physical changes are also reported. Ratings are based on the combined data.
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8th EDITION Permeation/Degradation Resistance Guide for Ansell Gloves

The first square in each column for each glove type is color coded to provide an overall rating for both Degradation and Permeation. The letter in each colored square is for Degradation alone.

- GREEN: The glove is very well suited for application with that chemical.
- YELLOW: The glove is suitable for that application under careful control of its use.
- RED: Avoid use of the glove with this chemical.

SPECIAL NOTE: The chemicals in this guide highlighted in BLUE are experimental carcinogens, according to the ninth edition of Sax' *Dangerous Properties of Industrial Materials*. Chemicals highlighted in GRAY are listed as suspected carcinogens, experimental carcinogens at extremely high dosages, and other materials which pose a lesser risk of cancer.

CHEMICAL	LAMINATE FILM BARRIER™			NITRILE SOL-VEX®			UNSUPPORTED NEOPRENE 29-SERIES			SUPPORTED POLYVINYL ALCOHOL PVA™			POLYVINYL CHLORIDE (Vinyl) SNORKEL®			NATURAL RUBBER *CANNERS AND HANDLERS™			NEOPRENE/ NATURAL RUBBER BLEND *CHEMI-PRO®			BUTYL UNSUPPORTED CHEMTEK™ BUTYL			VITON/BUTYL UNSUPPORTED CHEMTEK™ VITON/BUTYL		
	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate	Degradation Rating	Permeation: Breakthrough	Permeation: Rate
1. Acetaldehyde	■	380	E	P	—	—	E	10	F	NR	—	—	NR	—	—	E	13	F	E	10	F	—	—	—	—	—	—
2. Acetic Acid, Glacial, 99.7%	■	150	—	G	158	—	E	390	—	NR	—	—	F	45	G	E	110	—	E	263	—	E	>480	—	DD	>480	—
3. Acetone	▲	>480	E	NR	—	—	G	10	F	P	143	G	NR	<5	—	E	10	F	G	12	G	E	>480	E	DD	93	VG
4. Acetonitrile	▲	>480	E	F	30	F	E	20	VG	■	150	G	NR	—	—	E	4	VG	E	13	VG	E	>480	E	DD	70	E
5. Acrylic Acid	—	—	—	G	120	—	E	395	—	NR	—	—	NR	—	—	E	80	—	E	67	—	—	—	—	—	—	—
6. Acrylonitrile	▲	>480	E	—	—	—	—	—	—	▲	>480	—	—	—	—	E	5	F	—	—	—	E	>480	—	E	>480	—
7. Allyl Alcohol	▲	>480	E	F	140	F	E	140	VG	P	—	—	P	60	G	E	10	VG	E	20	VG	E	>480	—	E	>180	—
8. Ammonia Gas	■	19	E	▲	>480	E	▲	>480	—	—	—	—	—	—	—	—	—	—	■	27	E	—	—	—	—	—	—
9. Ammonium Fluoride, 40%	▲	>480	E	E	>360	—	E	>480	—	NR	—	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
10. Ammonium Hydroxide, Conc. (28-30% Ammonia)	E	30	—	E	>360	—	E	250	—	NR	—	—	E	240	—	E	90	—	E	247	—	E	>480	—	E	>480	—
11. n-Amyl Acetate	▲	470	E	E	198	G	NR	—	—	G	>360	E	P	—	—	NR	—	—	P	—	—	E	128	G	F	<10	F
12. Amyl Alcohol	▲	>480	E	E	>480	E	E	348	VG	G	180	G	G	12	E	E	25	VG	E	52	VG	E	>480	E	E	>480	E
13. Aniline	▲	>480	E	NR	—	—	E	145	F	F	>360	E	F	62	G	E	25	VG	E	82	G	E	>480	E	E	>480	E
14. Aqua Regia	—	—	—	F	>360	—	G	>480	—	NR	—	—	G	120	—	NR	—	—	G	193	—	E	>480	—	E	>480	—
15. Benzaldehyde	▲	>480	E	NR	—	—	NR	—	—	G	>360	E	NR	—	—	G	10	VG	G	27	F	E	>480	E	E	100	E
16. Benzene (Benzol)	▲	>480	E	P	—	—	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—	E	20	F	E	253	VG
17. Benzotrichloride	▲	>480	E	E	>480	E	NR	—	—	—	—	—	G	—	—	NR	—	—	NR	—	—	—	—	—	—	—	—
18. Benzotrifluoride	▲	>480	E	E	170	G	—	—	—	—	—	—	G	<10	F	P	50	G	P	—	—	—	—	—	—	—	—
19. Bromine Water	—	—	—	E	>480	E	E	>480	E	NR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
20. 1-Bromopropane (Propyl Bromide)	▲	>480	E	▼	23	F	▼	<10	P	▲	>480	E	▼	<10	F	▼	<10	P	▼	<10	P	▼	10	P	■	182	VG
21. 2-Bromopropionic Acid	▲	>480	—	F	120	—	E	460	—	—	—	—	G	180	—	E	190	—	G	190	—	—	—	—	—	—	—
22. n-Butyl Acetate	▲	>480	E	F	75	F	NR	—	—	G	>360	E	NR	—	—	NR	—	—	P	—	—	E	80	G	DD	<10	F
23. n-Butyl Alcohol	▲	>480	E	E	>360	E	E	270	E	F	75	G	G	180	VG	E	35	VG	E	75	VG	E	>480	E	E	>480	E
24. Butyl Carbitol	—	—	—	E	>323	E	G	188	F	E	>480	E	E	397	VG	E	44	G	E	148	G	—	—	—	—	—	—
25. Butyl Cellosolve	▲	>480	E	E	470	VG	E	180	G	■	120	G	P	60	G	E	45	G	E	48	G	E	>480	—	E	>480	—
26. gamma-Butyrolactone	▲	>480	E	NR	—	—	E	245	G	E	120	VG	NR	—	—	E	60	G	E	104	F	E	>480	E	E	>480	E
27. Carbon Disulfide	▲	>480	E	G	30	F	NR	—	—	E	>360	E	NR	<5	—	NR	—	—	NR	—	—	▼	7	G	■	138	E
28. Carbon Tetrachloride	—	—	—	G	150	G	NR	—	—	E	>360	E	F	25	F	NR	—	—	NR	—	—	F	53	P	—	—	—
29. Cellosolve® (Ethyl Glycol Ether, 2-Ethoxyethanol)	E	>480	E	G	293	G	E	128	G	■	75	G	P	38	G	E	25	VG	E	25	VG	E	>480	E	E	465	E
30. Cellosolve Acetate® (2-Ethoxyethyl Acetate, EGEAA)	▲	>480	E	F	90	G	G	40	F	■	>360	E	NR	—	—	E	10	G	E	23	G	E	>480	E	DD	105	VG

CHEMICAL	BARRIER				SOL-VEX				29-SERIES				PVA				SNORKEL				CANNERS AND HANDLERS®				CHEMI-PRO®				CHEMTEX BUTYL				CHEMTEX VITON/BUTYL			
31. Chlorine Gas	▲	>480	E	—	—	—	—	—	—	—	E	>360	E	NR	—	—	NR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
32. Chlorobenzene	▲	>480	E	NR	—	—	NR	—	—	F	50	VG	—	—	—	—	—	—	—	—	NR	—	—	—	P	—	P	9	P	F	>480	E	—	—	—	—
33. 4-Chlorobenzotrifluoride	—	—	—	E	320	—	—	F	50	F	50	VG	—	—	—	—	—	—	—	—	P	—	—	—	—	—	■	75	F	■	48	F	—	—	—	—
34. 2-Chlorobenzyl Chloride	E	120	E	—	—	—	—	F	200	E	200	E	>480	E	F	65	E	F	20	F	—	—	—	—	—	—	E	>480	E	E	>480	E	—	—	—	—
35. Chloroform	E	20	G	NR	—	—	NR	—	—	—	—	—	>360	E	NR	—	—	NR	—	—	NR	—	—	—	P	—	P	5	P	■	212	VG	—	—	—	—
36. 1-Chloronaphthalene	▲	>480	E	P	—	—	—	—	—	—	—	G	>360	E	NR	—	—	NR	—	—	P	—	—	—	E	—	E	>480	E	E	>480	E	—	—	—	—
37. 2-Chlorotoluene	▲	>480	E	G	120	G	NR	—	—	—	—	—	—	—	—	—	—	NR	—	—	NR	—	—	—	NR	—	—	—	—	E	—	—	—	—	—	—
38. 4-Chlorotoluene	▲	>480	E	P	—	—	NR	—	—	—	—	—	—	P	—	—	—	NR	—	—	NR	—	—	—	▼	30	F	▲	>480	E	—	—	—	—	—	—
39. "Chromic Acid" Cleaning Solution	—	—	—	—	F	240	—	NR	—	—	—	NR	—	G	>360	—	—	NR	—	—	NR	—	—	—	E	>480	—	E	>480	—	—	—	—	—	—	—
40. Citric Acid, 10%	—	—	—	E	>360	—	E	>480	—	F	50	—	E	>360	E	>360	—	E	>360	—	E	>480	—	—	—	—	—	—	—	—	—	—	—	—	—	—
41. Cyclohexane	—	—	—	▲	>360	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	G	30	F	▲	>480	—	—	—	—	—	—	—
42. Cyclohexanol	▲	>480	E	E	>360	E	E	390	VG	G	>360	E	E	360	E	E	103	VG	E	47	G	E	>480	E	E	>480	E	▲	>480	E	—	—	—	—	—	—
43. Cyclohexanone	▲	>480	E	F	103	G	P	23	F	E	>480	E	NR	—	—	P	—	—	P	—	—	—	—	E	>480	—	▼	150	—	—	—	—	—	—	—	—
44. 1,5-Cyclooctadiene	▲	>480	E	E	>480	E	NR	—	—	—	—	—	NR	—	—	NR	—	—	NR	—	—	—	P	—	—	—	—	—	—	—	—	—	—	—	—	—
45. Diacetone Alcohol	▲	>480	E	G	240	E	E	208	VG	■	150	G	NR	—	—	E	43	VG	E	60	VG	E	>480	—	DD	—	—	—	—	—	—	—	—	—	—	—
46. Dibutyl Phthalate	—	—	—	G	>360	E	F	132	G	E	>360	E	NR	—	—	E	20	—	G	>480	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
47. 1,2-Dichloroethane (Ethylene Dichloride, EDC)	▲	>480	E	NR	—	—	NR	—	—	E	>360	E	NR	—	—	P	—	—	P	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
48. Diethylamine	▲	>480	E	F	51	F	P	—	—	NR	—	—	NR	—	—	NR	—	—	NR	—	—	—	—	—	F	18	—	▼	19	—	—	—	—	—	—	—
49. Diisobutyl Ketone (DIBK)	▲	>480	E	E	263	G	P	—	—	G	>360	E	P	—	—	P	—	—	P	—	—	—	—	—	E	231	G	DD	15	G	—	—	—	—	—	—
50. Dimethyl Sulfoxide (DMSO)	▲	>480	E	E	240	VG	E	398	G	NR	—	—	NR	—	—	E	180	E	E	150	E	E	>480	—	DD	>480	—	—	—	—	—	—	—	—	—	—
51. Dimethylacetamide (DMAC)	▲	>480	E	NR	—	—	NR	—	—	NR	—	—	NR	—	—	E	15	G	E	30	G	E	>480	—	DD	>480	—	—	—	—	—	—	—	—	—	—
52. Dimethylformamide (DMF)	▲	>480	E	NR	—	—	E	45	F	NR	—	—	NR	19	—	E	25	VG	E	40	G	E	>480	E	DD	>480	E	—	—	—	—	—	—	—	—	—	—
53. Dioctyl Phthalate (DOP, DEHP)	▲	>480	E	G	>360	E	G	>480	E	E	30	F	NR	—	—	P	—	—	E	>360	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
54. Di-n-Octyl Phthalate (DNOP)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	E	>480	—	—	—	—	—	—	—	—	—	—	—
55. 1,4-Dioxane	▲	>480	E	NR	—	—	NR	—	—	P	—	—	NR	—	—	F	5	F	F	18	F	E	>480	—	—	—	—	—	—	—	—	—	—	—	—	—
56. Electroless Copper Plating Solution	—	—	—	E	>360	—	E	>360	—	NR	—	—	—	>360	—	E	>360	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
57. Electroless Nickel Plating Solution	—	—	—	E	>360	—	E	>360	—	NR	—	—	—	>360	—	E	>360	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
58. Epichlorohydrin	▲	>480	E	NR	—	—	P	—	—	E	300	E	NR	—	—	E	5	F	E	17	VG	E	>480	—	—	—	—	—	—	—	—	—	—	—	—	—	—
59. Ethidium Bromide, 10%	▲	>480	E	▲	>480	E	—	—	—	NR	—	—	—	—	—	—	—	—	—	—	—	E	>480	—	E	>480	—	E	>480	—	—	—	—	—	—	—	—
60. Ethyl Acetate	▲	>480	E	NR	—	—	F	10	P	F	>360	E	NR	—	—	G	5	F	F	10	F	E	196	G	DD	10	G	—	—	—	—	—	—	—	—	—	—
61. Ethyl Alcohol, Denatured, 92% Ethanol	▲	>480	E	E	240	VG	E	113	VG	NR	—	—	G	60	VG	E	15	VG	E	37	VG	E	>480	E	E	—	—	—	—	—	—	—	—	—	—	—	—
62. Ethylene Glycol	▲	>480	E	E	>360	E	E	>480	E	F	120	VG	E	>360	E	E	>360	E	E	>480	E	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
63. Ethylene Oxide Gas	■	234	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
64. Ethyl Ether	▲	>480	E	E	95	G	F	<10	F	G	>360	E	NR	—	—	NR	—	—	NR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
65. Ethyl L-Lactate	E	>480	E	E	273	G	E	125	VG	E	125	G	E	15	G	E	15	VG	E	28	VG	E	>480	E	E	>480	E	E	>480	E	E	>480	E	E	>480	E	E
66. Formaldehyde, 37% in 1/3 Methanol/Water	▲	>480	E	E	>360	E	E	39	VG	P	—	—	E	100	E	E	10	G	E	32	E	E	>480	—	E	>480	—	E	>480	—	—	—	—	—	—	—	—
67. Formic acid, 90%	▲	>480	—	F	240	—	E	>480	—	NR	—	—	E	>360	—	E	150	—	E	>360	—	E	>480	—	E	>480	—	E	>480	—	—	—	—	—	—	—	—
68. Furfural	▲	>480	E	NR	—	—	E	40	P	F	>360	E	NR	—	—	E	15	VG	E	43	VG	E	>480	—	G	>480	—	G	>480	—	—	—	—	—	—	—	—
69. Freon TF	—	—	—	E	>360	E	E	240	E	G	>360	E	NR	—	—	NR	—	—	NR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
70. Gasoline, Unleaded (Shell Premium winter blend)	▲	170	E	E	>480	E	NR	—	—	G	>360	E	P	—	—	NR	—	—	NR	—	—	—	—	—	F	20	F	E	>480	E	—	—	—	—	—	—	—
71. Glutaraldehyde, 25%	—	—	—	E	>360	E	E	>480	E	P	<10	F	E	>360	E	E	210	VG	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
72. HCFC-141B	▲	>480	E	E	92	F	F	33	F	P	—	—	NR	—	—	NR	—	—	NR	—	—	—	—	—	F	40	F	F	<10	F	—	—	—	—	—	—	—
73. n-Heptane	▲	>480	E	—	—	—	—	—	—	▲	>480	—	NR	—	—	—	—	—	—	—	—	—	—	—	P	10	F	E	>480	E	—	—	—	—	—	—	—
74. Hexamethyldisilazine	▲	>480	E	E	>360	—	E	42	—	G	>360	—	P	—	—	F	15	F	F	43	G	■	305	G	■	>480	G	—	—	—	—	—	—	—	—	—	—
75. n-Hexane	▲	>480	E	E	>480	E	E	48	G	G	>360	E	NR	—	—	NR	—	—	NR	—	—	P	5	F	E	>480	E	—	—	—	—	—	—	—	—	—	—
76. HFE 7100	▲	>480	E	E	>480	E	E	>480	E	P	—	—	E	>480	E	E	120	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
77. HFE 71DE	■	164	E	F	10	F	F	<10	F	F	>480	E	NR	—	—	NR	—	—	NR	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
78. Hydrazine, 65%	—	—	—	E	>480	—	E	386	—	NR	—	—	E	>360	—	E	150	VG	E	>360	—	E	>480	—	E	>480	—	—	—	—	—	—	—	—	—	—	—
79. Hydrobromic Acid, 48%	▲	>480	—	E	>360	—	E	>480	—	NR	—	—	E	>360	—	E	>360	—	E	>360	—	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—

80. Hydrochloric Acid, 10%	—	—	—	E	>360	—	E	>480	—	NR	—	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
81. Hydrochloric Acid, 37% (Concentrated)	▲	>480	—	E	>480	—	E	>480	—	NR	—	—	E	300	—	E	290	—	E	>360	—	—	—	—	—	—	—
82. Hydrofluoric Acid, 48%	▲	>480	—	E	334	—	■	>480	—	NR	—	—	■	155	—	▲	>480	—	—	—	—	E	>480	—	▲	>480	—
83. Hydrofluoric Acid, 95%	▲	>480	E	—	—	—	■	342	VG	—	—	—	—	—	—	—	—	—	—	—	—	▲	>480	E	—	—	—
84. Hydrogen Fluoride Gas	▲	>480	E	■	<15	P	—	—	—	—	—	—	■	2	—	■	15	F	■	<15	F	—	—	—	—	—	—
85. Hydrogen Peroxide, 30%	—	—	—	E	>360	—	E	>480	—	NR	—	—	E	>360	—	E	>360	—	G	>360	—	—	—	—	▲	>480	—
86. Hydroquinone, saturated solution	—	—	—	E	>360	E	E	108	E	NR	—	—	E	>360	E	G	>360	E	E	>360	E	—	—	—	—	—	—
87. Hypophosphorus Acid, 50%	—	—	—	E	>480	—	E	>240	—	NR	—	—	E	—	—	E	>480	—	—	—	—	—	—	—	—	—	—
88. Isobutyl Alcohol	▲	>480	E	E	>360	E	E	478	E	P	—	—	F	10	VG	E	15	VG	E	52	E	E	>480	E	E	>480	E
89. Isooctane	▲	>480	E	E	>360	E	E	268	VG	E	>360	E	P	—	—	NR	—	—	P	—	—	■	58	F	▲	>480	E
90. Isopropyl Alcohol	▲	>480	E	E	>360	E	E	110	E	NR	—	—	G	150	E	E	35	VG	E	57	E	—	—	—	—	—	—
91. Kerosene	▲	>480	E	E	>360	E	E	185	G	G	>360	E	F	>360	E	NR	—	—	P	—	—	G	82	—	E	>480	—
92. Lactic Acid, 85%	▲	>480	—	E	>360	—	E	>480	—	F	>360	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
93. Lauric Acid, 36% in Ethanol	—	—	—	E	>360	—	E	>480	—	NR	—	—	F	15	—	E	>360	—	E	>360	—	—	—	—	—	—	—
94. d-Limonene	▲	>480	E	E	>480	E	NR	—	—	G	>480	E	G	125	G	NR	—	—	NR	—	—	F	57	F	F	>480	E
95. Maleic Acid, saturated solution	—	—	—	E	>360	—	E	>480	—	NR	—	—	G	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
96. Mercury	—	—	—	▲	>480	E	—	—	—	—	—	—	▲	>480	E	▲	>480	E	—	—	—	—	—	—	—	—	—
97. Methyl Alcohol (Methanol)	▲	>480	E	E	103	VG	E	73	VG	NR	—	—	G	45	G	E	12	VG	E	22	E	E	>480	—	DD	363	—
98. Methylamine, 40%	▲	>480	E	E	>360	E	E	153	G	NR	—	—	E	135	VG	E	55	VG	E	100	E	E	>480	—	E	>480	—
99. Methyl Amyl Ketone (MAK)	▲	>480	E	F	53	F	F	10	F	E	>360	E	NR	—	—	F	<10	F	F	<10	F	E	155	G	DD	17	F
100. Methyl-t-Butyl Ether (MTBE)	E	>480	E	E	>360	E	P	—	—	G	>360	E	NR	—	—	NR	—	—	NR	—	—	G	38	F	—	—	—
101. Methyl Cellosolve®	■	470	F	F	208	G	E	10	F	E	30	G	P	55	G	E	20	VG	—	—	—	▲	>480	E	▲	>480	E
102. Methylene Bromide (DBM)	▲	>480	E	NR	—	—	NR	—	—	G	>360	E	NR	—	—	NR	—	—	NR	—	—	E	70	F	E	>480	E
103. Methylene Chloride (DCM)	E	20	VG	NR	—	—	NR	—	—	G	>360	E	NR	—	—	NR	—	—	NR	—	—	G	13	P	E	29	G
104. Methylene bis(4-Phenylisocyanate) (MDI)	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	▲	>480	E	▲	>480	E	—	—	—	—	—	—
105. Methyl Ethyl Ketone (MEK)	▲	>480	E	NR	—	—	P	—	—	F	90	VG	NR	—	—	F	5	F	P	<10	F	E	183	G	DD	20	G
106. Methyl Ethyl Ketone (MEK)/Toluene, 1/1	▲	>480	E	—	—	—	—	—	—	—	—	—	—	—	—	F	5	F	—	—	—	F	60	—	—	—	—
107. Methyl Iodide (Iodomethane)	▲	>480	E	NR	—	—	NR	—	—	F	>360	E	NR	—	—	NR	—	—	NR	—	—	F	15	P	G	215	VG
108. Methyl Isobutyl Ketone (MIBK)	▲	>480	E	P	45	F	NR	—	—	F	>360	E	NR	—	—	P	—	—	P	—	—	E	245	G	DD	30	G
109. Methyl Methacrylate (MMA)	▲	>480	E	P	35	P	NR	—	—	G	>360	E	NR	—	—	P	—	—	NR	—	—	E	85	G	DD	10	F
110. N-Methyl-2-Pyrrolidone (NMP)	▲	>480	E	NR	—	—	NR	—	—	NR	—	—	NR	—	—	E	75	VG	F	47	VG	E	>480	—	DD	—	—
111. Mineral Spirits, Rule 66	▲	>480	E	E	>480	E	E	125	G	E	>360	E	F	150	VG	NR	—	—	G	23	G	—	—	—	—	—	—
112. Monoethanolamine	—	—	—	E	>360	E	E	400	E	E	>360	E	E	>480	E	E	50	E	E	57	E	—	—	—	■	>120	—
113. Morpholine	▲	>480	E	NR	—	—	P	—	—	G	90	G	NR	—	—	G	20	G	E	43	G	E	>480	E	DD	235	VG
114. Naphtha, VM&P	▲	>480	E	E	>360	E	G	103	G	E	420	E	F	120	VG	NR	—	—	NR	—	—	—	—	—	—	—	—
115. Nitric Acid, 10%	▲	>480	—	E	>360	—	E	>480	—	NR	—	—	G	>360	—	G	>360	—	E	>360	—	—	—	—	—	—	—
116. Nitric Acid, 70% (Concentrated)	E	>480	—	NR	—	—	▲	>480	—	NR	—	—	F	109	—	NR	—	—	NR	—	—	—	—	—	—	—	—
117. Nitric Acid, Red Fuming	▲	>480	E	NR	—	—	NR	—	—	NR	—	—	P	—	—	P	—	—	NR	—	—	—	—	—	—	—	—
118. Nitrobenzene	▲	>480	E	NR	—	—	NR	—	—	G	>360	E	NR	—	—	F	15	G	F	42	G	E	>480	—	E	>480	—
119. Nitromethane	▲	>480	E	F	30	F	E	60	G	G	>360	E	P	—	—	E	10	G	E	30	E	E	>480	E	E	249	E
120. 1-Nitropropane	■	368	E	NR	—	—	F	30	G	E	>480	G	NR	—	—	E	15	G	E	25	G	E	>480	E	DD	255	E
121. 2-Nitropropane	▲	>480	E	NR	—	—	F	25	F	E	>360	E	NR	—	—	E	5	G	E	30	VG	—	—	—	—	—	—
122. n-Octyl Alcohol	—	—	—	E	>360	E	E	218	E	G	>360	E	F	>360	E	E	30	VG	E	53	G	—	—	—	—	—	—
123. Oleic Acid	—	—	—	E	>360	E	F	13	VG	G	60	E	F	90	VG	F	>360	E	G	120	—	—	—	—	—	—	—
124. Oxalic Acid, saturated solution	—	—	—	E	>360	—	E	>480	—	P	—	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
125. Pad Etch® 1 (Ashland Chemical)	—	—	—	E	>360	—	E	>360	—	F	34	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
126. Palmitic Acid, saturated solution	—	—	—	G	30	—	E	>480	—	P	—	—	G	75	—	G	5	—	E	193	—	—	—	—	—	—	—
127. Pentachlorophenol, 5% in Mineral Spirits	—	—	—	E	>360	E	E	151	F	E	5	F	F	180	E	NR	—	—	—	—	—	—	—	—	—	—	—
128. n-Pentane	E	>480	E	E	>360	E	G	30	G	G	>360	E	NR	—	—	P	—	—	E	13	G	—	—	—	—	—	—

129. Perchloric Acid, 60%	—	—	—	E	>360	—	E	>480	—	NR	—	—	E	>360	—	F	>360	—	E	>360	—	—	—	—	—	—	—
130. Perchloroethylene (PERC)	▲	>480	E	G	361	VG	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—	P	<10	F	E	>480	E
131. Phenol, 90%	▲	>480	E	NR	—	—	E	353	G	F	>360	E	G	75	VG	E	90	—	E	180	E	E	>480	—	E	>480	—
132. Phosphoric Acid, 85% (Concentrated)	▲	>480	—	E	>360	—	G	>360	—	NR	—	—	G	>360	—	F	>360	—	G	>360	—	—	—	—	—	—	—
133. Potassium Hydroxide, 50%	—	—	—	E	>360	—	E	>480	—	NR	—	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
134. Propane Gas	—	—	—	▲	>480	E	▲	>480	E	—	—	—	■	7	VG	—	—	—	—	—	—	—	—	—	—	—	—
135. n-Propyl Acetate	—	—	—	F	20	G	P	—	—	G	120	VG	NR	—	—	P	—	—	P	—	—	E	135	G	DD	<10	F
136. n-Propyl Alcohol	E	>480	E	E	>360	E	E	323	E	P	—	—	F	90	VG	E	23	VG	E	30	E	E	>480	—	E	>480	—
137. Propylene Glycol Methyl Ether Acetate (PGMEA)	▲	>480	E	E	200	F	G	37	F	E	>360	E	P	—	—	G	13	F	G	18	F	▲	>480	E	■	334	E
138. Propylene Glycol Monomethyl Ether (PGME)	—	—	—	—	—	—	P	—	—	—	—	—	P	—	—	—	—	—	—	—	—	▲	>480	E	▲	>480	E
139. Propylene Oxide	▲	>480	E	NR	—	—	NR	—	—	G	35	G	NR	—	—	P	—	—	P	—	—	■	43	F	DD	<10	F
140. Pyridine	▲	>480	E	NR	—	—	NR	—	—	G	10	F	NR	—	—	F	10	F	P	10	F	▲	465	E	DD	40	—
141. Rubber Solvent	—	—	—	E	>360	E	E	43	G	E	>360	E	NR	—	—	NR	—	—	NR	—	—	—	—	—	—	—	—
142. Silicon Etch	▲	>480	E	NR	—	—	E	>480	—	NR	—	—	F	150	—	NR	—	—	P	—	—	—	—	—	—	—	—
143. Skydrol® 500B-4	▲	>480	E	NR	—	—	NR	—	—	—	—	—	NR	—	—	NR	—	—	NR	—	—	E	>480	E	DD	>480	E
144. Sodium Hydroxide, 50%	E	>480	—	E	>360	—	E	>480	—	NR	—	—	G	>480	—	E	>360	—	E	>360	—	E	>480	—	E	>480	—
145. Stoddard Solvent	▲	>480	E	E	>360	E	E	139	G	E	>360	E	F	57	G	NR	—	—	G	10	G	—	—	—	—	—	—
146. Styrene	▲	>480	E	NR	—	—	NR	—	—	G	>360	E	NR	—	—	NR	—	—	NR	—	—	G	26	—	E	>480	—
147. Sulfur Dichloride	—	—	—	P	>480	E	NR	—	—	—	—	—	—	—	—	NR	—	—	NR	—	—	—	—	—	—	—	—
148. Sulfuric Acid, 47% (Battery Acid)	—	—	—	E	>360	—	E	>360	—	NR	—	—	G	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
149. Sulfuric Acid, 95-98% (Concentrated)	E	>480	E	NR	—	—	F	24	—	NR	—	—	G	26	—	NR	—	—	NR	—	—	E	>480	—	E	>480	—
150. Sulfuric Acid, 120% (Oleum)	▲	>480	E	—	—	—	F	53	G	NR	—	—	▼	25	G	—	—	—	—	—	—	—	—	—	—	—	—
151. Tannic Acid, 65%	—	—	—	E	>360	—	E	>480	E	P	—	—	E	>360	—	E	>360	—	E	>360	—	—	—	—	—	—	—
152. Tetrahydrofuran (THF)	▲	>480	E	NR	—	—	NR	—	—	P	115	F	NR	—	—	NR	—	—	NR	—	—	F	13	F	DD	10	F
153. Toluene (Toluol)	▲	>480	E	F	34	F	NR	—	—	G	>1440	E	NR	—	—	NR	—	—	NR	—	—	P	20	F	E	313	—
154. Toluene Diisocyanate (TDI)	▲	>480	E	NR	—	—	NR	—	—	G	>360	E	P	—	—	G	7	G	G	65	VG	E	>480	—	E	>480	—
155. Triallylamine	▲	>480	E	▲	>480	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
156. Trichloroethylene (TCE)	▲	>480	E	NR	—	—	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—	NR	—	—	DD	204	VG
157. Tricresyl Phosphate (TCP)	—	—	—	E	>360	E	F	253	F	G	>360	E	F	>360	E	E	45	E	E	>360	E	E	>480	—	E	>480	—
158. Triethanolamine (TEA)	—	—	—	E	>360	E	E	170	VG	G	>360	E	E	>360	E	G	>360	E	—	—	—	—	—	—	—	—	—
159. Turpentine	▲	>480	E	E	>480	E	NR	—	—	G	>360	E	P	—	—	NR	—	—	NR	—	—	■	58	—	■	>480	E
160. Vertrel® MCA	▲	>480	E	E	110	G	E	23	G	F	>360	E	G	13	F	G	<10	F	G	<10	F	■	173	VG	DD	20	G
161. Vertrel® SMT	E	10	G	P	—	—	F	<10	F	G	17	G	G	<10	F	F	<10	F	P	<10	P	▼	18	F	DD	<10	F
162. Vertrel® XE	E	105	E	E	>480	E	E	47	G	F	40	VG	G	303	E	E	17	VG	E	43	VG	E	>480	E	DD	398	E
163. Vertrel® XF	E	>480	E	E	>480	E	E	>480	E	F	387	VG	E	>480	E	E	337	VG	E	204	G	E	>480	E	DD	>480	E
164. Vertrel® XM	E	>480	E	E	>480	E	E	105	E	F	10	G	P	55	G	E	23	VG	E	30	VG	—	—	—	—	—	—
165. Vinyl Acetate	▲	>480	E	F	18	F	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	NR	—	—
166. Vinyl Chloride Gas	▲	>480	E	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—	—
167. Xylenes, Mixed (Xylol)	▲	>480	E	G	96	F	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—	P	27	F	E	>480	E

▲ A degradation test against this chemical was not run. However, since its breakthrough time is greater than 480 minutes, the Degradation Rating is expected to be Good to Excellent. ■ A degradation test against this chemical was not run. However, in view of degradation tests performed with similar compounds, the Degradation Rating is expected to be Good to Excellent. ▼ A degradation test against this chemical was not run. However, in view of data obtained with similar compounds, the Degradation Rating is expected to be Fair to Poor. *CAUTION: This product contains natural rubber latex which may cause allergic reactions in some individuals.

NOTE:

These recommendations are based on laboratory tests, and reflect the best judgement of Ansell in the light of data available at the time of preparation and in accordance with the current revision of ASTM F 739. They are intended to guide and inform qualified professionals engaged in assuring safety in the workplace. Because the conditions of ultimate use are beyond our control, and because we cannot run permeation tests in all possible work environments and across all combinations of chemicals and solutions, these recommendations are advisory only. The suitability of a product for a specific application must be determined by testing by the purchaser.

The data in this guide are subject to revision as additional knowledge and experience are gained. Test data herein reflect laboratory performance of partial gloves and not necessarily the complete unit. Anyone intending to use these recommendations should first verify that the glove selected is suitable for the intended use and meets all appropriate health standards. Upon written request, Ansell will provide a sample of material to aid you in making your own selection under your own individual safety requirements.

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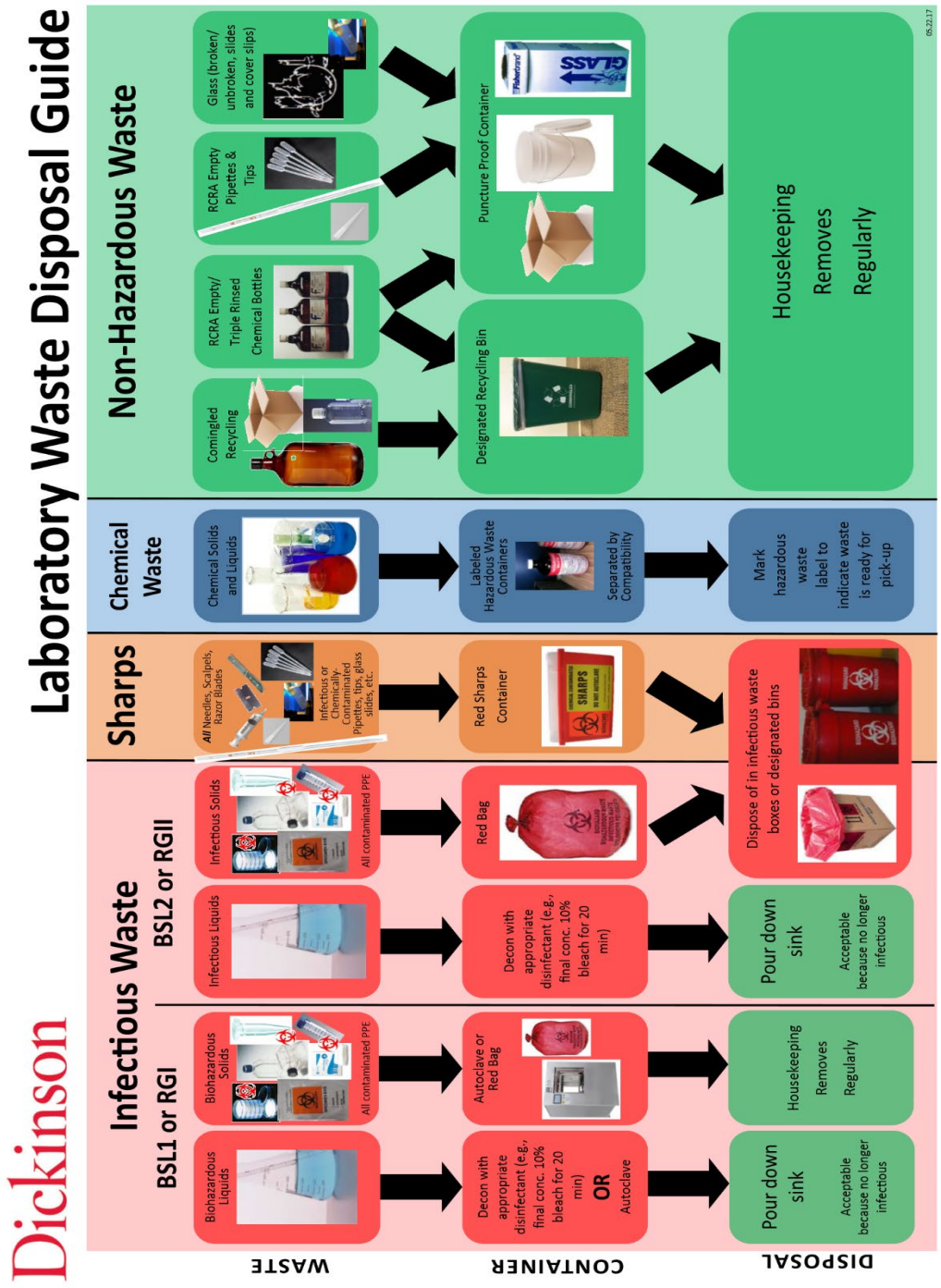
Appendix G: Laboratory Waste Flow Chart



Appendix H: Chemical Waste Classes Poster

Chemical Waste Classes

Do NOT Mix Classes—Keep each category separate

Inorganic Acids Examples: Hydrochloric Acid (HCl) Sulfuric Acid (H_2SO_4) Ferric Chloride ($FeCl_3$) Copper Sulfate ($CuSO_4$)	**Organic Acids** Examples: Acetic Formic Trichloroacetic Acetic Anhydride	**Oxidizing Acids** Examples: Perchloric Nitric Chromic
Bases, liquids and solids Examples: Hydroxides Phosphates Ammonia (NH_3)	**Flammable Bases** Examples: Trimethylamine Trimethylchlorosilane	**Flammable Liquids** Examples: Acetone Toluene Acetonitrile Methanol Ethyl Acetate Heptane Hexane Oil based paint
Compressed Gas and Aerosols Examples: Compressed gas cylinders Aerosol Cans	**Toxic Organic** Examples: Non-flammable chlorinated solvents Pesticides Ethidium Bromide Acrylamide Chloroform Methylene Chloride Formaldehyde Phenol	**Toxic Inorganic** Examples: Mercury Lead Zinc Sodium Azide
Air/Water Reactive Examples: Grignard reagents Alkali metals Reactive halides (acetyl chloride) Sodium borohydride	**Oxidizers** Examples: All nitrates Potassium Dichromate Metal Peroxides	**Organic Peroxides** Examples: Benzoyl peroxide Methyl Ethyl Ketone peroxide
High Hazards Peroxide Formers Examples: Aged Ether Tetrahydrofuran 1,4-dioxane Di– and tri-nitro compounds	**Nonhazardous Waste**	See ***How to Fill out Hazardous Waste Labels*** poster for instructions on how to fill out the hazardous waste label Have questions? Need labels? Contact the Dept. of Compliance & Enterprise Risk Management at 717-245-1495

Helpful Advice:

- Enter information on tag as waste is added to the container.
- Keep waste in closed (sealed) containers.
- Do not put solid waste material (paper, plastic, etc…) into liquid waste containers.
- Do not mix incompatible chemicals in the same container.
- Do not put corrosive chemicals in metal containers.
- Do not overfill containers. Prevent leakage by leaving empty space at the top of the container.
- Clean visible contamination from the outside of the container.
- Place leaking waste containers in a secondary container and contact Compliance & Enterprise Risk Management as soon as possible for disposal.
- Leave tagged containers in a visible place.
- Refer to the Dickinson College Chemical Hygiene Plan and Comprehensive Waste Management Plan for further guidance.