This Section outlines general safety procedures and policies that apply to all laboratory work. The Safety Committee may establish additional requirements to address potential hazards that could result from specific operations.

Given the diversity of laboratory operations, this Manual does not include specific information about all potential laboratory hazards. Faculty members are relied upon to use their best judgment in identifying hazards in their laboratory. Additionally, given the generic nature of some of the policies and procedures of this Manual, there may be situations where alternative procedures would provide a greater level of safety. If a faculty member believes that an alternative procedure would provide a greater level of safety, the Safety Committee must be contacted for clarification and permission.

The attitude of those working in the laboratory is one of the most important factors in the safe conduct of laboratory experiments. All stages of an investigation, from design through completion, must consider safety as a guiding principle. The key to designing and carrying out safe laboratory experiments is knowledge of the potential hazards. **It is the responsibility of each individual working in the laboratory to become thoroughly familiar with the hazards of the chemicals they are using and operations they are performing.**

4.1 CONTROLLING SOURCES OF EXPOSURE

All experiments must be designed and carried out to minimize hazardous chemical exposure. Source reduction, engineering controls, and protective equipment, in that order, are the three primary means of controlling exposure. The following are examples of source reduction and engineering control techniques.

Source Reduction

- Use the least hazardous chemical that will serve the intended purpose.
- Design experiments to use the minimum amount of hazardous chemical required.
- Always close containers when not in use.
- Minimize the surface area of open containers (e.g. use of flask vs. beaker).

Engineering Controls

- Use fume hoods whenever possible.
- Do not use fume hoods for long term storage of equipment or chemicals.
- Avoid the release of hazardous chemicals in rooms with no ventilation system or with re-circulating air systems.
- Use equipment and glassware only for its designed purpose. Never use damaged equipment or glassware.
- If operations must be left unattended, provide for containment of hazardous chemicals in the event of equipment failure.

Protective Equipment

Minimum levels of protective equipment are described in Section 4.5. It should be recognized, however, that source reduction and engineering controls are generally more effective means of exposure control.

4.2 PERSONAL HYGIENE

Good personal hygiene practices are essential to minimize hazardous chemical exposure and potential injury from other hazardous conditions, such as broken glass, in the laboratory.

- **The storage or consumption of food or beverages, application of make-up, and smoking are prohibited in all laboratory areas and hazardous chemical storage areas.**
- Avoid "routine" exposures. Do not taste and avoid smelling any hazardous chemicals. Never mouth pipette.
- Wash hands immediately upon contamination, after handling hazardous chemicals and before leaving the laboratory.
- Long hair and loose clothing must be confined when working in the laboratory.
- A soiled or contaminated lab coat should be placed in a plastic bag and exchanged for a clean one; contact the Lab Manager.
- **Shoes must be worn at all times in Cole Science Center.**
- Closed-toe shoes must be worn when working with hazardous chemicals or biological materials, or when moving heavy objects. Sandals or perforated shoes are not acceptable, as feet are not protected from spills or falling objects.
- Please note that even if you are not actively working on a project yourself but are inside the lab, you are still at risk from the activities of others around you. Therefore, all safety precautions still apply.

4.3 HOUSEKEEPING

Keeping the laboratory work area organized and clean is important to safe handling of hazardous chemicals. Only the equipment and chemicals necessary for the particular procedure being performed should be in the work area. This is particularly important when working in a fume hood as storage of numerous containers or pieces of equipment can severely diminish the effectiveness of the hood. If several people are working in the same laboratory, requirements for space and hood access should be discussed and work areas agreed upon.

Floors and surfaces should be kept clean and spills cleaned up immediately as described in Section 2. The entire work area should be cleaned at the end of each day.

4.3.1 Lab Project Termination

When a lab project is completed, will cease to be active for a period of time, or the faculty member or student leaves Hampshire College, clean-up must be done by the faculty member and student, and approved by the Lab Manager. Clean up includes:

- remove and properly dispose of all hazardous materials from the laboratory or project area, and from any shared storage units, refrigerators, stock rooms, chemical cabinets, and waste collection areas
- clean and decontaminate all laboratory equipment, hoods, bench tops, cabinets, and shelves

These procedures are intended to reduce the number of unidentified and unwanted hazardous materials and wastes in the laboratory, thereby reducing disposal costs, and providing a clean and safe lab for work.

The Lab Manager inspects for proper clean-up and handling of hazardous materials, and will notify the Dean of Natural Science if proper clean-up, disposal and decontamination procedures have been followed, and that the faculty and her/his student have fulfilled responsibilities for cleanup. Clean-up becomes the responsibility of the faculty member if not completed by the student.

Any problems resulting from improper management or clean up of hazardous materials at close-out will be addressed by the Dean of Natural Science, and if necessary, the Dean of Faculty or Dean of Students.

4.4 PETS IN THE LABORATORY

Pets are not allowed in the laboratory.

4.5 UNATTENDED OPERATIONS

Avoid leaving operations unattended. When it is necessary to leave an experiment unattended, provide for containment of hazardous chemicals in the event of equipment failure. Additionally, leave the lights on and place a warning sign on the door if, in the event of an emergency, there exists a hazard to persons entering the room.

4.6 SAFETY DATA SHEETS AND LAB SAFETY INFORMATION

The OSHA Laboratory Standard defines a "hazardous chemical" as one that exhibits physical or health hazards.

> *"Physical Hazard" - a chemical for which there is scientifically valid evidence that it is a combustible liquid, a compressed gas, explosive, flammable, an organic peroxide, an oxidizer, pyrophoric, unstable (reactive) or water reactive.*
> *"Health Hazard" - a chemical for which there is statistically significant evidence based on at least one study conducted in accordance with established scientific principles that acute or chronic health effects may occur...includes...carcinogens, toxic or highly toxic agents, reproductive toxins, irritants, corrosives, sensitizers, hepatotoxins, nephrotoxins, neurotoxins, agents which act on the hematopoietic (blood) system, and agents which damage the lung, skin, eyes, or mucous membranes.*

Determining the hazard of a chemical is the responsibility of the manufacturer of the chemical. Information on the hazards of a particular chemical can be found on the label, the manufacturer's Safety Data Sheet (SDS), and in reference publications listed in the Bibliography.
Safety Data Sheets received from the manufacturer are available to all users of the CSC. SDS contain detailed chemical information including:

- the contents of a given product
- physical, chemical, and toxicological hazards associated with that material
- appropriate personal protective equipment and clothing necessary (e.g., appropriate type of gloves, goggles)
- safe handling and disposal guidelines
- emergency procedures, including care and contact personnel (e.g., poison contact)

SDS for CSC materials are located in an on-line library available through a link on The Hub. A fact sheet on how to read a SDS is included in Appendix 4-A.
There are several systems for categorizing the severity of chemical hazards. It is important to recognize the similarities and differences of those system. Two common systems, the Global Harmonization System (required on SDS) and National Fire Protection Association Hazard Identification System, are described in Appendix 4-B.

4.7 CHEMICAL INVENTORY, TRANSPORT, AND SHIPPING

All chemicals must be included in the CSC chemical inventory. When a new chemical is received it must be tagged and entered into the inventory by the faculty member or Lab Manager. When containers are emptied or the chemical disposed of, the date must be entered into the inventory. When chemicals are moved from one storage location to another, the location on the inventory must be updated. Chemicals taken from a storage area for temporary use in the laboratory do not need to have the location changed.

A bottle carrier or cart must be used when moving any quantity of an acute toxin and 1 liter or greater containers of flammables or concentrated acids or bases from the stockroom to the laboratory or between laboratories. The use of a bottle carrier or cart is recommended when moving other chemicals from the stockroom to the laboratory and between laboratories.

All shipments of hazardous materials (e.g. chemicals, biological materials) from Hampshire College to other locations must comply with all Department of Transportation (DOT) and International Air Transport Association (IATA) requirements. The Laboratory Manager must notify the Chemical Hygiene Officer prior to shipping chemicals and hazardous materials. All chemical and hazardous materials shipments must be approved to ensure that materials are packaged and labeled properly and that the proper documentation accompanies the shipment. The Laboratory Manager is responsible for forwarding all records pertaining to shipments to the Chemical Hygiene Officer.

4.8 PERSONAL PROTECTIVE EQUIPMENT

Protective equipment must be worn to guard against injury from routine or accidental events. Each faculty or supervising staff member is responsible for choosing appropriate protective equipment for his or her staff and students. The following personal protective equipment is available for persons working in the laboratory. Know what equipment is necessary for your work.

4.8.1 Eye and Face Protection

The hazards of each laboratory operation must be identified and the approved eyewear worn. Eye protection meeting ANSI Standard Z87.1, as summarized in Table 4-1 below, is the minimum level of eye protection required.

Table 4-1
Summary of ANSI Z87.1-98
Approved Protective Eyewear

HAZARDS	**APPROVED EYEWEAR**
IMPACT: flying objects, fragments, particles	1,2,3,4,5,6
HEAT: hot sparks	1,2,3,4,5,6
HEAT: high temperature	1,2,3,5,6
CHEMICAL: splash	3,4, or 5(with 3 or 4)
CHEMICAL: irritating mists	4
DUSTS: airborne particles	3,4,6
IR/UV RADIATION: welding, soldering, brazing, cutting	Refer to ANSI Z87.1-89
1. Safety Spectacles, with side shields 2. Goggles, flexible fit, regular ventilation 3. Goggles, flexible fit, hooded ventilation	4. Goggles, rigid body, cushioned fit 5. Face Shield, plastic window 6. Chipping Goggles, eyecup type

Wearing contact lenses is highly discouraged when working with or near chemicals, particularly solvents.

4.8.1.1 Operations Requiring Chemical Splash Goggles

To protect students, faculty, staff and visitors from chemical eye hazards, the following operations require chemical splash goggles. When these operations are conducted in a fume hood with the sash lowered, safety glasses are acceptable.

1. Use of strong acids or bases (outside pH range of 2 – 10).
2. Use of corrosive gases.
3. Use of potentially explosive or water reactive chemicals (as defined in Section 5.3).
4. Use of acutely toxic chemicals (as defined in Section 5.6) in liquid or powder form.
5. Use of cryogenic liquids when there is a risk or pressure buildup or splash or particle hazard.
6. Use of other hazardous chemicals in liquid form.
7. Any activity when there is an explosion or implosion hazard.

Goggles must be worn by the person whose activity causes the hazard, and by adjacent individuals. Faculty, staff, teaching assistants and visitors working with students who are required to wear splash goggles must also wear splash goggles. Faculty are responsible for identifying any additional operations in their laboratory which pose a splash hazard and therefore require splash goggles.

Chemical splash goggles are available in boxes marked "Goggles" located throughout the lab areas. These goggles meet the American National Standards Institute Z87.1 standards (1998). Face shields are also available for additional protection; chemical splash goggles must be worn under face shields.

4.8.1.2 Operations Requiring Safety Glasses or Splash Goggles

The following operations require the use of safety glasses or splash goggles.

1. Operations using or generating liquid or fine particulate chemicals for which splash goggles are not required.
2. Chipping, cutting and grinding activities.
3. UV and/or IR protective safety glasses are required when working with instruments generating and releasing UV or IR emissions unless a safety mechanism automatically shuts of the emission source when exposure is possible. Refer to ANSI Z87.1-89.
4. When installing or removing regulators on gas cylinders.

4.8.2 Gloves

The need to wear gloves, and selection of the appropriate gloves, depend on: the hazard of the chemical, the potential for contamination during the experiment, and dexterity requirements. It is the responsibility of the faculty to choose the appropriate gloves for their staff and students.

Proper glove selection is a function of the specific chemical resistance of the material as measured by permeation rate and breakthrough time. **Disposable latex gloves have limited resistance to most commonly used laboratory hazardous chemicals. They should not be used without investigating their resistance to the chemicals being used, or in operations where contamination is anticipated.** When contaminated they must be removed immediately and the hands washed. Use of latex gloves also poses a risk of serious allergic symptoms in sensitive individuals and of other individuals developing a latex allergy.

More resistant gloves include natural rubber, neoprene, nitrile, butyl, Viton, and polyvinyl chloride. Nitrile gloves are available in the stockroom; other gloves should be ordered as needed.

Recommendations of the glove manufacturer and the Material Safety Data Sheet for the particular hazardous chemical should be used in choosing the appropriate glove.

Best Manufacturing Company at http://www.bestglove.com/aspx/default.aspx

Ansell Occupational Health Care at http://www.ansellpro.com/download/Ansell_7thEditionChemicalResistanceGuide.pdf

Oklahoma State University at http://www.pp.okstate.edu/ehs/hazmat/gloves5.htm

4.8.3 Clothing

The purpose of protective clothing is to prevent contamination of the skin and to prevent the carrying of contaminants outside the laboratory. Street clothes may afford limited skin protection but may result in contaminants being carried outside the laboratory. Bulky or dangling attire and easily combustible clothing should not be worn in lab.

Protective Clothing - The use of a lab coat is strongly recommended in all laboratories. Lab coats must be worn in the laboratory when handling:

- any quantity of Select Carcinogens (see 5.8) or Reproductive Toxins (see 5.7) that are absorbed through the skin
- any quantity of Acute Toxins (see 5.6).
- greater than 25 mL of strong acids or bases (outside pH range 2 – 10)

Lab coats are available from the Lab Manager. A soiled or contaminated lab coat should be placed in a plastic bag and exchanged for a clean one; contact the Lab Manager.

All protective clothing should be removed before leaving the lab area, to keep potential contamination restricted to the lab area.

Additional specialized protective clothing should also be used in certain high hazard operations, for example, when using hydrofluoric acid (see Section 5.2.4). Again, it is the responsibility of the faculty to choose the appropriate protective equipment for their staff and students.

Protective Footwear - **Shoes must be worn at all times** in Cole Science Center. When working with hazardous chemical or biological materials, or moving heavy objects, closed-toe shoes must be worn. Sandals or perforated shoes are not acceptable, as feet are not protected from spills or falling objects.

4.9 HOODS

There are several different types of hoods in Cole Science Center. Each of these is discussed briefly below. *The appropriate hood must be used.* Use of the wrong type of hood could increase the potential hazard. All hoods are tested annually to verify proper performance.

4.9.1 General Use Fume Hoods

These hoods, which are designed to protect the user, are appropriate for working with flammables, acids, bases and organic solvents; they should be operated with the sash lowered to the indicated point (red arrow). Working with the sash lowered to this point creates the necessary draw (air flow into the hood), and adds protection from splashes or explosion.

1. Before using a fume hood observe the following precautions.

   - Remove any bulky items in the hood as these will prevent proper airflow.
   - Turn the hood on and confirm that the hood is drawing air (a tissue or kimwipe held at the opening should be gently pulled into the hood area).
   - Do not store chemicals in the hoods, or remove stored chemicals before use.

2. When using a fume hood observe the following precautions.

   - Do not keep unnecessary materials in the hood.
   - Chemicals or waste stored in a hood must be in secondary containment.
   - Use only intrinsically safe (i.e., explosion proof) equipment when working with flammables. (Intrinsically safe equipment is available from the Lab Manager.)
   - Keep all materials back at least 6 inches inside the hood. The sash should be able to be fully closed in the event of an emergency.
   - Work with the sash lowered to the indicated level (red arrows) for proper venting.
   - Be aware of air disturbances (from opening doors, fans, passers by, etc.), as these will affect the draw of air into the hood.
   - Do not attach signs or materials to the sash as these prevent visibility into the hood and safe operation of the sash.

- Clean up spills immediately. Ask the instructor or Lab Manager for the appropriate way to do this, as some materials must be treated first (e.g., acids and bases must be neutralized).

4.9.2 Laminar Flow Hoods and Biological Safety Cabinets

Laminar Flow hoods are used to protect microbiological work from contamination; they contain no UV lamp source. These are also called clean benches, and are used for work with non-hazardous materials when very clean environments are needed for high purity work. The operator sits downstream of the materials and airflow; therefore, toxic, infectious and hazardous materials should never be used in laminar flow hoods.

Biological safety cabinets (a.k.a. tissue culture hoods) are used for hazardous microbiological work such as work with pathogens; they are designed to protect the person, the product and the environment for operations requiring Biosafety Level 1 and 2, such as tissue culture analysis and bacteriological or virological applications. These hoods contain an ultraviolet lamp source and HEPA filters which are 99.9% efficient for particles of size 0.03 um.

These types of hoods do not protect the user from hazardous vapors. At this time, Hampshire does not have a hood that provides protection from chemical vapors while providing a sterile hood environment.

4.10 ELECTRICAL SAFETY

The voltage and current used in laboratories are potentially lethal. The Lab Manager should be notified if unsafe electrical situations exist (e.g., wires are strung across pathways, frayed wires are found, grounding plugs have been removed), or if equipment malfunctions.

Instruments are serviced regularly following the manufacturer's guidelines. Instruments that are out of service should be "locked-out". Lockout prevents equipment from being turned on or operated while it is being repaired or inspected; equipment cannot be restarted until repairs are complete and the lockout removed. Only trained individuals should perform equipment repair or modification.

4.10.1 Electrophoresis Safety

Electrophoresis is a lab technique that presents a potential hazard as the user manipulates wires with high voltage. When working with electrophoresis, the following precautions must always be followed:

- the bench and floor in the area should be dry
- the high voltage leads should be intact, the connections secure, and no plugs should be exposed
- all electrophoresis chambers should be covered when in use

- all power supplies should be turned to zero voltage and current after use, and all leads should be unplugged from the unit (power supplies have internal capacitance that stores electrical charge even after the units are turned off, and accidental discharge can be fatal)
- use only one hand to plug and unplug high voltage leads, do not put the other hand in a position that will ground you, resulting in a potentially lethal shock across the chest
- do not operate an electrophoresis system without appropriate supervision and a buddy present

4.11 MACHINE TOOLS

The use of stationary machine tools and powered hand tools is subject to the following requirements.

1. Use of machine tools and power hand tools must be done under the instruction and direct supervision of a faculty or staff member familiar with the hazards and appropriate safeguards for the tool being used.

2. All machine tools must be stored in a locked area or locked out when a supervising faculty or staff member is not present.

3. Choose the right tool for the job. Makeshift or undersized tools are always a hazard.

4. Eye protection must be worn at all times. Safety glasses with side shields meeting ANSI Standard Z87.1-89 are the minimum level of protection. Goggles may be advisable under certain situations.

5. Be sure all safeguards are in place and working before starting work. Guards as supplied by the manufacturer must be used when operating equipment. Fabricated tools guards must meet OSHA requirements.

6. Check portable power tools for poor wiring or loose switches. Do not use a tool with a frayed cord or with the grounding prong removed.

7. Chuck keys, calipers, gauges, and other tools should be removed immediately after use. Forgetting to do so may lead to the tool becoming a projectile when the machine is started.

8. Never wear gloves, wristwatches, rings, bracelets, or other jewelry while operating machinery. Long hair and loose clothing should be controlled near operating machinery. Rags, drawings, hand tools, lubricant containers and other loose objects should be kept away from moving machine parts and machine surfaces that may vibrate during machine operation.

9. Use a vise or clamps to secure the work when possible.

10. When using portable tools do not overreach. Keep good balance and proper footing at all times.

11. Be aware of potential hazards in your work area. Don't overlook the hazards and workspace requirements of others working nearby. When operating power tools in a strange environment check for flammable liquids, combustible materials and other hazards before beginning work.

12. Keep out of the way of things that may be thrown by machinery. Some machines produce large amounts of debris. Debris not caught by the machine's dust collection system may be propelled out of the machine in a particular direction and distract or obstruct the vision of the operator. Some machines may also eject stock material under some circumstances. Table saws and wood jointers for example will eject wood stock in the direction of the rotation of the blade if the material is improperly fed. These machines should be operated from one side, minimizing any possible hazards.

13. Chips and debris should be cleaned with a brush and not with compressed air or by hand.

14. The machining of pyrophoric metals (such as magnesium) or toxic metals (such as beryllium, cadmium, lead, and osmium) requires special precautions. Any work on these types of materials requires approval of the Safety Office.

15. Do not remove stock or reach near any moving parts of a machine until those parts have come to a complete stop. Turning the machine "off" does not immediately halt the hazardous motion of many machines.

16. Machine adjustments or lubricating may be done while the machine is operating only if no safeguards are removed or bypassed and only if the operator is not exposed to any hazardous energy.

17. Repair and servicing must be done in accordance with the Hampshire College Lockout/Tagout Program.

APPENDIX 4-A

How to read a SDS

Safety Data Sheets (SDS) inform the purchasers and users of hazardous chemicals of the properties and hazards of the chemical. The OSHA Hazard Communication Standard, 29 CFR 1910.1200, requires chemical manufacturers and distributors to develop SDS for their products and provide the SDS to their customers. Employers are in turn required to make the SDS available to all employees using or exposed to the product.

OSHA requires that the SDS provide certain information in a specific format containing 16 sections. That 16-part format is briefly described below.

Section 1: Identification includes product identifier; manufacturer or distributor name, address, phone number; emergency phone number; recommended use; restrictions on use.

Section 2: Hazard(s) identification includes all hazards regarding the chemical; required label elements.

Section 3: Composition/information on ingredients includes information on chemical ingredients; trade secret claims.

Section 4: First-aid measures includes important symptoms/ effects, acute, delayed; required treatment.

Section 5: Fire-fighting measures lists suitable extinguishing techniques, equipment; chemical hazards from fire.

Section 6: Accidental release measures lists emergency procedures; protective equipment; proper methods of containment and cleanup.

Section 7: Handling and storage lists precautions for safe handling and storage, including incompatibilities.

Section 8: Exposure controls/personal protection lists OSHA's Permissible Exposure Limits (PELs); Threshold Limit Values (TLVs); appropriate engineering controls; personal protective equipment (PPE).

Section 9: Physical and chemical properties lists the chemical's characteristics.

Section 10: Stability and reactivity lists chemical stability and possibility of hazardous reactions.

Section 11: Toxicological information includes routes of exposure; related symptoms, acute and chronic effects; numerical measures of toxicity.

Section 12: Ecological information includes information on toxicity to aquatic and/or terrestrial organism, environmental persistence, bioaccumulation, and other adverse environmental effects.

Section 13: Disposal considerations provided guidance on proper disposal practices.

Section 14: Transport information includes classification information for shipping of hazardous chemicals

Section 15: Regulatory information identified safety, health, and environmental regulations specific for the product.

Section 16) Other information, includes the date of preparation or last revision.

APPENDIX 4-B

Hazard Rating Systems

Several organizations have developed numerical rating systems for classifying hazards.

With OSHA's adoption of the Global Harmonization System (GHS), SDS are now required to list hazard categories established by that system.

There are 10 health hazard classes, each of which is divided into categories which include:

1. Acute Toxicity, Categories 1-4 (with 1 being the most dangerous, 4 the least dangerous)
2. Skin Corrosion/Irritation, Categories 1A, 1B, 1C, and 2
3. Serious Eye Damage/Eye Irritation, Categories 1, 2A, and 2B
4. Respiratory or Skin Sensitization, Category 1A and 1B
5. Germ Cell Mutagenicity, Categories 1A, 1B, and 2
6. Carcinogenicity, Categories 1A, 1B, and 2
7. Reproductive Toxicity, Categories 1A, 1B, 2, and additional category for effects on or via lactation
8. Specific Target Organ Toxicity - Single Exposure (STOT-SE), Categories 1-3
9. Specific Target Organ Toxicity - Repeated or Prolonged Exposure (STOT-RE), Categories 1 and 2
10. Aspiration Hazard, Category 1

The 16 physical hazard classes and their associated hazard include:

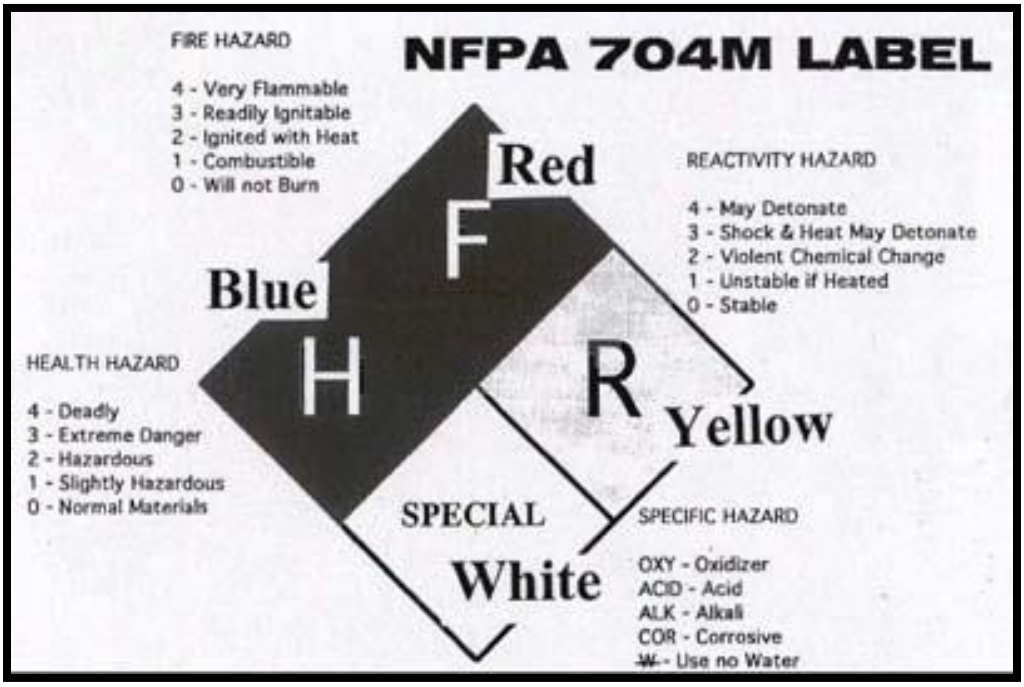
1. Explosives, Divisions 1.1-1.6 (with 1.1 being the most hazardous, 1.6 the least hazardous)
2. Flammable Gases, Categories 1 and 2
3. Flammable Aerosols, Categories 1 and 2
4. Oxidizing Gases, Category 1
5. Gases Under Pressure, 4 Groups include: Compressed gas, Liquefied gas, Dissolved gas, and Refrigerated liquefied gas
6. Flammable Liquids, Categories 1-4
7. Flammable Solids, Categories 1 and 2
8. Self-Reactive Chemicals, Types A-G
9. Pyrophoric Liquids, Category 1
10. Pyrophoric Solids, Category 1
11. Self-Heating Chemicals, Categories 1 and 2
12. Chemicals Which, in Contact with Water, Emit Flammable Gases, Categories 1-3
13. Oxidizing Liquids, Categories 1-3
14. Oxidizing Solids, Categories 1-3
15. Organic Peroxides, Types A-G
16. Corrosive to Metals, Category 1

Details of the category definitions can be found in 9 CFR1910.1200 Appendix A. **In general under the GHS system, the lower the number the higher the degree of hazard.** Similarly if there are subcategories such as A and B, an A is a higher hazard ranking than a B. As examples:

- a material corrosive to skin is a category 1 while an irritant to skin is a category 2
- a category 1 carcinogen is a known or presumed human carcinogen (1A being known , 1B being presumed) while a category 2 carcinogen is a suspect human carcinogen

Another system that is widely used is the *Standard System for the Identification of the Fire Hazards of Materials* published by the National Fire Protection Association in NFPA 704. **Under the NFPA system, the lower the number the lower the degree hazard.**

The label used is the popular "NFPA diamond" used on many manufacturers' labels and storage tanks. Reactivity information is displayed in the right-hand, yellow portion of the diamond. The reactivity hazard is ranked, as are the fire and health hazards, using an ordinal ranking system with values of 0 to 4. In addition, the lower portion of the diamond is used to note Special Warnings including water (or moisture) reactives and oxidizing materials. Some suppliers of laboratory chemicals are displaying the NFPA diamond on container labels. Fisher Scientific does this and also includes a colored bar indicating storage code.



Although it is the most common system, NFPA 704 has several important limitations. First, the influence of quantity still requires judgment by the person using the chemical. For example, how much of a very reactive material can be safely handled with a given procedure. The second limitation is evident from the official title of the Standard. Its

original purpose was to "safeguard the lives of those individuals who may be concerned with fires occurring in an industrial plant or storage location where the fire hazards of materials may not be readily apparent". It was not designed directly for laboratory decision-making. Even with these limitations the NFPA labeling system is a very useful first reference for reactivity hazards and an important emergency response information system. The following are definitions from the NFPA 704 system for reactivity.

NFPA Reactivity Rating Reactivity (Stability)

The assignment of degrees in the reactivity category is based upon the susceptibility of materials to release energy by themselves or in combination with water. Fire exposure was one of the factors considered along with conditions of shock and pressure.

NFPA Instability (Reactivity) Rating	
4	Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperatures and pressures. This degree usually includes materials that are sensitive to localized thermal or mechanical shock at normal temperatures and pressures.
3	Materials that in themselves are capable of detonation or of explosive decomposition or explosive reaction but that require a strong initiating source which must be heated under confinement before initiation. This degree usually includes: materials that are sensitive to thermal or mechanical shock at elevated temperatures and pressures; materials that react explosively with water without requiring heat or confinement.
2	Materials that readily undergo violent chemical change at elevated temperatures and pressures. This degree usually includes: materials that exhibit an exotherm at temperatures less than or equal to 150^{o}C when tested by differential scanning calorimetry; and that may react violently with water or form potentially explosive mixtures with water.
1	Materials that in themselves are normally stable, but which can become unstable at elevated temperatures and pressures. This degree usually includes: materials that change or decompose on exposure to air, light, or moisture; materials that exhibit an exotherm at temperatures greater than 150^{o}C, but less than or equal to 300^{o}C, when tested by differential scanning calorimetry.
0	Materials that in themselves are normally stable, even under fire exposure conditions, and which are not reactive with water.

NFPA Health Rating

The assignment of degrees in the health hazard category is based upon the capability of materials to cause personal injury due to contact with or entry into the body via inhalation, ingestion, skin contact, or eye contact.

NFPA Health Rating	
4	Materials that, under emergency conditions, can be lethal.
3	Materials that, under emergency conditions, can cause serious or permanent injury.

2	Materials that, under emergency conditions, can cause temporary incapacitation or residual injury.
1	Materials that, under emergency conditions, can cause significant irritation.
0	Materials that, under emergency conditions, would offer no hazard beyond that of ordinary combustible materials.

NFPA Flammability Rating

The assignment of degrees in the flammability hazard category is based upon the susceptibility of materials to burning.

NFPA Flammability Rating	
4	Materials that will rapidly or completely vaporize at atmospheric pressure and normal ambient temperature or that are readily dispersed in air and will burn readily.
3	Liquids and solids that can be ignited under almost all ambient temperature conditions. Materials in this degree produce hazardous atmospheres with air under almost all ambient temperatures or, though unaffected by ambient temperatures, are readily ignited under almost all conditions.
2	Materials that must be moderately heated or exposed to relatively high ambient temperatures before ignition can occur. Materials in this degree would not under normal conditions form hazardous atmospheres with air, but under high ambient temperatures or under moderate heating could release vapor in sufficient quantities to produce hazardous atmospheres with air.
1	Materials that must be preheated before ignition can occur. Materials in this degree require considerable preheating, under all ambient temperature conditions, before ignition and combustion can occur.
0	Materials that will not burn under typical fire conditions, including intrinsically noncombustible materials such as concrete, stone, and sand.