CHEMICAL HYGIENE PROGRAM

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WEST VIRGINIA UNIVERSITY

CHEMICAL HYGIENE PROGRAM

OSHA 29 CFR 1910.1450

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FORWARD

West Virginia University is committed to protecting the safety and health of its employees, students, visitors and the environment. The Occupational Safety and Health Administration (OSHA) Laboratory Standard (OSHA 29 CFR 1910.1450) specifies the mandatory requirements of an established Chemical Hygiene Plan (CHP) to protect laboratory workers from harm due to chemical exposure. A CHP is required for each individual laboratory and approved space in which chemicals are used, and each plan should be unique and reflect the specific chemical hazards in use. **This program alone does not serve as a complete CHP.** EHS has a developed a Laboratory-Specific CHP template to assist individuals with writing a unique CHP. Contact Environmental Health and Safety (EHS) for assistance ensuring that a developed CHP is in compliance with set regulations.

SCOPE

The West Virginia University Environmental Health and Safety Chemical Hygiene Program applies to all laboratory personnel who handle and may be exposed to hazardous chemicals during the course of their work. This includes laboratories, studios, and other designated areas that use small quantities of off-the-shelf hazardous chemicals.

This Chemical Hygiene Program is intended to:

- inform laboratory employees of the potential health and safety hazards present in their workplace.
- inform laboratory employees of the precautions and preventive measures that have been established by this organization to protect employees from a workplace illness or injury.
- inform laboratory employees of the required safety rules and procedures established by this organization to meet the requirements of OSHA 29 CFR 1910.1450 and OSHA 29 CFR 1910.1200

EMPLOYEE RIGHTS AND RESPONSIBILITIES

Employees have the right to be informed about the known health and safety hazards of the chemical substances in their work areas and to be properly trained to work safely with these substances.

Employees have the responsibility to:

- participate in training seminars on the Laboratory Standard;
- stay informed about the chemicals used in their work areas;
- use safe work practices and required protective equipment for safe performance of their job; and
- inform their supervisors of accidents and conditions or work practices they believe to be a hazard to their health or to the health of others.

CHPs MUST be reviewed, approved, and signed (with date) annually by the appropriate designated parties (see Appendix B for a Sample CHP Approval Document). A record of this annual review will be kept with the CHP to be referenced when requested. The Laboratory Supervisors, Principal Investigators and Department Chairs are responsible for the interpretation and enforcement of policies described in the CHP. WVU Environmental Health and Safety recommends archiving past approved versions of CHPs.

Emergency Phone Numbers:

FOR ALL MEDICAL EMERGENCIES CALL 911

University Police (UPD) – Main Campus	304-293-2677 (COPS)
University Police (non-emergency)	304-293-4357 (HELP)
Environmental Health and Safety	304-293-3792
(after normal business hours call UPD)	

DEFINITIONS

Common Acronyms	
ASME:	American Society of Mechanical Engineers
ASTM:	American Society for Testing and Materials
CFR:	Code of Federal Regulations
CGA:	Compressed Gas Association
CHO:	Chemical Hygiene Officer
CHP:	Chemical Hygiene Plan
DOT:	United States Department of Transportation
EPA:	Environmental Protection Agency
GHS:	Globally Harmonized System
SDS:	Safety Data Sheet
OSHA:	Occupational Safety and Health Administration of the United States Department of Labor
WVDEP:	West Virginia Division of Environmental Protection

Absolute Pressure: Pressure based on a zero reference point, the perfect vacuum.

Action Level: A concentration designated in OSHA regulations for a specific substance, calculated as an 8-hour time weighted average (TWA), that initiates certain required activities.

Approved: Acceptable to the authority having jurisdiction

Authority Having Jurisdiction (AHJ): An organization, office or individual responsible for enforcing the requirements of a code or standard or for approving equipment, materials installation or a procedure. For the purpose of this section it is the West Virginia Fire Marshals' Office.

Building Code: The building or construction code adopted by the jurisdiction.

Bulk Oxygen System: An assembly of equipment, such as oxygen storage containers, pressure regulators, pressure relief devices, vaporizers, manifolds, and interconnecting piping, with a storage capacity of more than 20,000 ft^3 of oxygen including unconnected reserves on hand at the site. The bulk oxygen system terminates at the point where oxygen, at service pressure, first enters the supply line. The oxygen containers are either stationary or movable and the source gas is stored as a compressed gas or as a cryogenic liquid.

Ceiling Limit: The maximum concentration of an airborne contaminant to which a person might be exposed. The ceiling limits utilized are those published in OSHA 29 CFR 1910.1000.

Combustible Liquid: A liquid having a closed-cup flash point at or above 100°F (37.8°C), subdivided as follows: Class II liquids have a flash point at or above 100°F (37.8°C) and below 140°F (60°C); Class IIIA liquids have a flash point at or above 140°F (60°C) and below 200°F (93.4°C); Class IIIB liquids have a flash point at or above 200°F (93.4°C).

Compressed Gas: A material or mixture of materials that is a gas at 20°C (68°F) or less at an absolute pressure of 14.696 psia and that has a boiling point of 20°C (68°F) at an absolute pressure of 14.7 psia and that is liquefied, nonliquefied or in solution, except those gases that have no other health or physical hazard properties are not considered to be compressed gases until the pressure in the package exceeds an absolute pressure of 40.6 psia at 20°C (68°F).

Compressed Gas Container: A pressure vessel designed to hold compressed gas at an absolute pressure greater than one (1) atmosphere at 20°C (68°F) that include cylinders, containers and tanks.

Compressed Gas System: An assembly of equipment designed to contain, distribute or transport compressed gases.

Container: A vessel. Such as a cylinder, portable tank or stationary tank, that varies in shape, size and material of construction.

Control Area: A designated area, either indoors or outdoors within which limited quantities of hazardous materials are allowed to be stored, used, handled or dispensed.

Corrosive Gas: A gas that causes visible destruction of or irreversible alterations in living tissue by chemical action at the site of contact.

Court: An open, uncovered, unoccupied space, unobstructed to the sky, bounded on three or more sides by exterior walls.

Cryogenic Fluid: A fluid with a boiling point lower than -90°C (-130°F) at an absolute pressure of 14.7psia.

Cylinder: A pressure vessel designed for pressures higher than 40 psia and having a circular cross-section. It does not include a portable tank, multiunit tank car tank, cargo tank or tank car.

Designated Area: An area established for work with substances that have a high degree of acute toxicity. This can be an entire laboratory, a region within a laboratory, or an appropriate device, such has a fume hood.

Distributor: A business engaged in the sale or resale or both of compressed gases or cryogenic fluids or both.

Emergency Shutoff Valve: A designated valve designed to shut off the flow of gases or liquids.

Exhausted Enclosure: An appliance or piece of equipment that consists of a top, a back and two sides that provides a means of local exhaust for capturing gases, fumes, vapors and mists.

Flammable Gas: A material that is a gas at 20°C (68°F) or less at an absolute pressure of 14.7 psia, that is ignitable at an absolute pressure of 14.7 psia when in a mixture of 13 percent or less by volume with air or that has a flammable range at an absolute pressure of 14.7 psia with air of at least 12 percent regardless of the lower limit.

Flammable Liquids: Class I, any liquid having a closed-cup flash point below 100°F (37.8°C).

Gallon: A standard U.S. measuring unit for liquids, equivalent to 128 fluid ounces. (1 gallon = 3.785 L)

Gas Cabinet: A fully enclosed, noncombustible enclosure used to provide an isolated environment for compressed gas cylinders in storage and use.

Gas Room: A separately ventilated, fully enclosed room which only compressed gases, cryogenic fluids, associated equipment and supplies are stored or used.

Globally Harmonized System (GHS) – an international approach to hazard communication, providing agreed criteria for classification of chemical hazards, and a standardized approach to label elements and safety data sheets. See Appendix G for OSHA's Hazard Communication Standard Pictograms.

Handling: The deliberate movement of material in containers by any means to a point of storage or use.

Hazard Rating: The numerical rating of the health, flammability and self-reactivity and other hazards of the material, including its reaction with water as specified in NFPA 704, Standard System for the Identification of the Hazards of Materials for Emergency Response.

Health Hazard: a chemical that is classified as posing one of the following hazardous effects: Acute toxicity (any route of exposure); skin corrosion or irritation; serious eye damage or eye irritation; respiratory or skin sensitization; germ cell mutagenicity; carcinogenity; reproductive toxicity; specific target organ toxicity (single or repeated exposure); aspiration hazard. The criteria for determining whether a chemical is classified as a health hazard are detailed in appendix A of the Hazard Communication Standard (§1910.1200) and §1910.1200(c) (definition of "simple asphyxiant"). The following was extracted from the mentioned regulations.

1. "Carcinogen:" A chemical is considered to be a carcinogen if:
    (a) It has been evaluated by the International Agency for Research on Cancer (IARC), and found to be a carcinogen or potential carcinogen; or
    (b) It is listed as a carcinogen or potential carcinogen in the Annual Report on Carcinogens published by the National Toxicology Program (NTP) (latest edition); or,
    (c) It is regulated by OSHA as a carcinogen.
2. "Corrosive:" 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 to be corrosive if, when tested on the intact 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.
3. "Highly toxic:" A chemical falling within any of the following categories:
    (a) A chemical that has a median lethal dose (LD(50)) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.
    (b) A chemical that has a median lethal dose (LD(50)) of 200 milligrams or less per kilogram 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.

(c) A chemical that has a median lethal concentration (LC(50)) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less 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.

4. "Irritant:" 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.

5. "Sensitizer:" 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.

6. "Toxic." A chemical falling within any of the following categories:

(a) A chemical that has a median lethal dose (LD(50)) of more than 50 milligrams per kilogram but not more than 500 milligrams per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

(b) A chemical that has a median lethal dose (LD(50)) of more than 200 milligrams per kilogram but not more than 1,000 milligrams per kilogram 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.

(c) A chemical that has a median lethal concentration (LC(50)) in air of more than 200 parts per million but not more than 2,000 parts per million by volume of gas or vapor, or more than two milligrams per liter but not more than 20 milligrams per liter 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.

7. "Target organ effects."

The following is a target organ categorization of effects which may occur, including examples of signs and symptoms and chemicals which have been found to cause such effects. These examples are presented to illustrate the range and diversity of effects and hazards found in the workplace, and the broad scope employers must consider in this area, but are not intended to be all - inclusive.

(a) Hepatotoxins: Chemicals which produce liver damage
Signs & Symptoms: Jaundice; liver enlargement; Chemicals: Carbon tetrachloride; nitrosamines

(b) Nephrotoxins: Chemicals which produce kidney damage; Signs & Symptoms: Edema; proteinuria

Chemicals: Halogenated hydrocarbons; uranium

(c) Neurotoxins: Chemicals which produce their primary toxic effects on the nervous system;

Signs & Symptoms: Narcosis; behavioral changes; decrease in motor functions

Chemicals: Mercury; carbon disulfide

(d) Agents which act on the blood or hemato-poietic system: Decrease hemoglobin function; deprive the body tissues of oxygen; Signs & Symptoms: Cyanosis; loss of consciousness

Chemicals: Carbon monoxide; cyanides

(e) Agents which damage the lung: Chemicals which irritate or damage pulmonary tissue

Signs & Symptoms: Cough; tightness in chest; shortness of breath

Chemicals: Silica; asbestos

(f) Reproductive toxins: Chemicals which affect the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis); Signs & Symptoms: Birth defects; sterility

Chemicals: Lead; DBCP

(g) Cutaneous hazards: Chemicals which affect the dermal layer of the body

Signs & Symptoms: Defatting of the skin; rashes; irritation

Chemicals: Ketones; chlorinated compounds

(h) Eye hazards: Chemicals which affect the eye or visual capacity; Signs & Symptoms: Conjunctivitis; corneal damage; Chemicals: Organic solvents; acids

Simple asphyxiant means a substance or mixture that displaces oxygen in the ambient atmosphere, and can thus cause oxygen deprivation in those who are exposed, leading to unconsciousness and death.

Highly Toxic Gas: A chemical that has a median lethal concentration (LC_{50}) in air of 200ppm by volume or less of gas or vapor or 2 mg/L or less of mist, fume or dust, when administered by continuous inhalation for 1 hour (or less if death occurs) to albino rats weighing between 200 grams and 300 grams each.

"in use": the status of a cylinder that is properly attached, ready, and intended for use.

Indoor Area: An area that is within a building or structure having overhead cover, other than a structure qualifying as "weather protection".

Inert Gas: A nonreactive, nonflammable, noncorrosive gas such as argon, helium, krypton, neon, nitrogen and xenon.

Irritant Gas: A chemical that is not corrosive but that 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 skin of albino rabbits by the method of 16 CFR 1500.41 for an exposure of 4 or more hours or by other appropriate techniques, it results in an empirical score of 5 or more. A chemical is classified as an eye irritant if so determined under the procedure listed in 16 CFR 1500.42 or other appropriate techniques.

Labeled: Equipment or materials to which has been attached a label, symbol or other identifying mark of an organization that is acceptable to the authority having jurisdiction and concerned with product evaluation, that maintains periodic inspection of production labeled equipment or materials and by whose labeling the manufacturer indicates compliance with appropriate standards or performance in a specified manner.

Lachrymatory: A substance that has the effect of causing the secretion of tears.

Listed: Equipment, materials or services included in a list published by an organization that is acceptable to the authority having jurisdiction and concerned with evaluation of products or services, that maintain periodic inspection of production of listed equipment or materials or periodic evaluation of services and whose listing states that either equipment, material or service meets appropriate designated standards or has been tested and found suitable for specified purpose.

Maximum Allowable Quantity Per Control Area (MAQ): A threshold quantity of hazardous materials in a specific hazard class that once exceeded requires the application of additional administrative procedures, construction features or engineering controls.

Nesting: A method of securing cylinders upright in a tight mass using a contiguous three-point contact system whereby all cylinders in a group have a minimum of three points with other cylinders or a solid support structure (for example, a wall or railing).

Noncombustible Material: A material that, in the form in which it is used and under the conditions anticipated, will not ignite, burn, support combustion or release flammable vapors, when subjected to fire or heat. Materials that are reported as passing ASTM E 136 are considered noncombustible materials.

Normal Temperature and Pressure (NTP): A temperature of 21°C (70°F) at an absolute pressure of 14.7 psia.

Other Gas: A gas that is not a corrosive gas, flammable gas, highly toxic gas, oxidizing gas, pyrophoric gas, toxic gas, or an unstable reactive gas with a hazard rating of Class 2, Class 3 or Class 4.

Oxidizing Gas: A gas that can support and accelerate combustion of other materials.

Particularly Hazardous Substances (PHS): chemicals with special acute or chronic toxicity. The OSHA Laboratory Standard defines a PHS as being a select carcinogen, reproductive toxin, or having a high degree of acute toxicity. http://web.ornl.gov/sci/psd/mst/rsg/pdf/OSHA_Haz_List_.pdf

Permissible Exposure Limits (PEL): the maximum permitted 8-hour, time weighted average concentration of an airborne contaminant.

Physical Hazard: a chemical that is classified as posing one of the following hazardous effects: Explosive; flammable (gases, aerosols, liquids, or solids); oxidizer (liquid, solid, or gas); self-reactive; pyrophoric (gas, liquid or solid); self-heating; organic peroxide; corrosive to metal; gas under pressure; in contact with water emits flammable gas; or combustible dust. The criteria for determining whether a chemical is classified as a physical hazard are in appendix B of the Hazard

Communication Standard (§1910.1200) and §1910.1200(c) (definitions of "combustible dust" and "pyrophoric gas"). All definitions provided below were extracted and alphabetized from Appendix B of §1910.1200.

(a) *Aerosol* means any non-refillable receptacle containing a gas compressed, liquefied or dissolved under pressure, and fitted with a release device allowing the contents to be ejected as particles in suspension in a gas, or as a foam, paste, powder, liquid or gas.

(b) *Chemicals which, in contact with water, emit flammable gases* are solid or liquid chemicals which, by interaction with water, are liable to become spontaneously flammable or to give off flammable gases in dangerous quantities.

(c) A *chemical which is corrosive to metals* means a chemical which by chemical action will materially damage, or even destroy, metals.

(d) An *explosive chemical* is a solid or liquid chemical which is in itself capable by chemical reaction of producing gas at such a temperature and pressure and at such a speed as to cause damage to the surroundings. Pyrotechnic chemicals are included even when they do not evolve gases.

(e) An *explosive item* is an item containing one or more explosive chemicals.

(f) *Flammable gas* means a gas having a flammable range with air at 20°C (68°F) and a standard pressure of 101.3 kPa (14.7 psi).

(g) *Flammable liquid* means a liquid having a flash point of not more than 93°C (199.4°F).

(h) *Flammable solid* means a solid which is a readily combustible solid, or which may cause or contribute to fire through friction.

(i) *Flash point* means the minimum temperature at which a liquid gives off vapor in sufficient concentration to form an ignitable mixture with air near the surface of the liquid, as determined by a method identified in Section B.6.3.

(j) *Gases under pressure* are gases which are contained in a receptacle at a pressure of 200 kPa (29 psi) (gauge) or more, or which are liquefied or liquefied and refrigerated. They comprise compressed gases, liquefied gases, dissolved gases and refrigerated liquefied gases.

(k) An *intentional explosive* is a chemical or item which is manufactured with a view to produce a practical explosive or pyrotechnic effect.

(l) *Organic peroxide* means a liquid or solid organic chemical which contains the bivalent -0-0- structure and as such is considered a derivative of hydrogen peroxide, where one or both of the hydrogen atoms have been replaced by organic radicals. The term organic peroxide includes organic peroxide mixtures containing at least one organic peroxide. Organic peroxides are thermally unstable chemicals, which may undergo exothermic self-accelerating decomposition. In addition, they may have one or more of the following properties:

(a) Be liable to explosive decomposition;
(b) Burn rapidly;
(c) Be sensitive to impact or friction;
(d) React dangerously with other substances.

Note: An organic peroxide is regarded as possessing explosive properties when in laboratory testing the formulation is liable to detonate, to deflagrate rapidly or to show a violent effect when heated under confinement.

(m) *Oxidizing gas* means any gas which may, generally by providing oxygen, cause or contribute to the combustion of other material more than air does.

Note: "Gases which cause or contribute to the combustion of other material more than air does" means pure gases or gas mixtures with an oxidizing power greater than 23.5% (as determined by a method specified in ISO 10156 or 10156-2 (incorporated by reference, See §1910.6)or an equivalent testing method.)

(n) *Oxidizing liquid* means a liquid which, while in itself not necessarily combustible, may, generally by yielding oxygen, cause, or contribute to, the combustion of other material.

(o) *Oxidizing solid* means a solid which, while in itself is not necessarily combustible, may, generally by yielding oxygen, cause, or contribute to, the combustion of other material.

(p) *Pyrophoric liquid* means a liquid which, even in small quantities, is liable to ignite within five minutes after coming into contact with air.

(q) *Pyrophoric solid* means a solid which, even in small quantities, is liable to ignite within five minutes after coming into contact with air.

(r) A *pyrotechnic chemical* is a chemical designed to produce an effect by heat, light, sound, gas or smoke or a combination of these as the result of non-detonative self-sustaining exothermic chemical reactions.

(s) A *pyrotechnic item* is an item containing one or more pyrotechnic chemicals.

(t) *Readily combustible solids* are powdered, granular, or pasty chemicals which are dangerous if they can be easily ignited by brief contact with an ignition source, such as a burning match, and if the flame spreads rapidly.

(u) A *self-heating chemical* is a solid or liquid chemical, other than a pyrophoric liquid or solid, which, by reaction with air and without energy supply, is liable to self-heat; this chemical differs from a pyrophoric liquid or solid in that it will ignite only when in large amounts (kilograms) and after long periods of time (hours or days).

Note: Self-heating of a substance or mixture is a process where the gradual reaction of that substance or mixture with oxygen (in air) generates heat. If the rate of heat production exceeds the rate of heat loss, then the temperature of the substance or mixture will rise which, after an induction time, may lead to self-ignition and combustion.

(v) *Self-reactive chemicals* are thermally unstable liquid or solid chemicals liable to undergo a strongly exothermic decomposition even without participation of oxygen (air). This definition excludes chemicals classified under this section as explosives, organic peroxides, oxidizing liquids or oxidizing solids. A self-reactive chemical is regarded as possessing explosive properties when in laboratory testing the formulation is liable to detonate, to deflagrate rapidly or to show a violent effect when heated under confinement.

(w) An *unstable explosive* is an explosive which is thermally unstable and/or too sensitive for normal handling, transport, or use.

Portable Tank: Any packaging over 60 U.S. Gallons in capacity designed primarily to be loaded into or on or temporarily attached to a transport vehicle or ship and equipped with skids, mountings or accessories to facilitate handling of the tank by mechanical means.

Protection Level 1: Occupancies used for the storage or use of unstable reactive Class 4 and unstable reactive Class 3 detonable compressed gases in quantities that exceed the thresholds for gases requiring special provisions shall be classified Protection Level 1.

Protection Level 2: Occupancies used for the storage or use of flammable, pyrophoric and non-detonable, unstable reactive Class 3 compressed gases or cryogenic fluids in quantities that exceed the quantity thresholds for gases requiring special provisions shall be classified as Protection Level 2.

Protection Level 3: Occupancies used for the storage or use of oxidizing and unstable reactive Class 2 compressed gases or cryogenic fluids in quantities that exceed the quantity thresholds for gases requiring special provisions shall be classified as Protection Level 3.

Protection Level 4: Occupancies used for the storage or use of toxic, highly toxic and corrosive compressed gases in quantities that exceed the quantity thresholds for gases requiring special provisions shall be classified as Protection Level 4.

Protection Level 5: Buildings and portions thereof used for fabrication of semiconductors or semiconductor research and development and containing quantities of hazardous materials exceeding the maximum allowable quantities of high hazard level 5 contents permitted in control areas shall be classified as Protection Level 5.

Pyrophoric Gas: A gas with an auto-ignition temperature in air at or below 54.4°C (130°F).

Safety Data Sheet (SDS): Formerly called Material Safety Data Sheet; written or printed material concerning a hazardous material that is prepared in accordance with the provisions of OSHA 29 CFR 1910.1200. See Appendix C for an overview.

Shall: Indicates a mandatory requirement.

Short Term Exposure Limit (STEL): The concentration to which it is believed that workers can be exposed continuously for a short period of time without suffering from irritation, chronic or irreversible tissue damage, or narcosis of a degree sufficient to increase the likelihood of accidental injury, impairment of self-rescue or the material reduction of work efficiency, without exceeding the daily permissible exposure limit (PEL).

Should: Indicates a recommendation or that which is advised but not required.

Stationary Tank: A packaging designed primarily for stationary installations not intended for loading, unloading or attachment to a transport vehicle as part of the normal operation in the process of use.

Storage: An inventory of compressed gases or cryogenic fluids in containers that are not in the process of being examined, services, refilled, loaded or unloaded.

Toxic Gas: A gas with a median lethal concentration (LC50) in air of more than 200 ppm but not more than 2,000 ppm by volume of gas or vapor or more than 2 mg/L, but not more than 20 mg/L or mist, fume or dust when administered by continuous inhalation for 1 hour (or less if death occurs) to albino rats weighing between 200 grams and 300 grams each.

Treatment System: An assembly of equipment capable of processing a hazardous gas and reducing the gas concentration to a predetermined level at the point of discharge from the system to the atmosphere.

Unstable Reactive Gas: A gas that, in the pure state or as commercially produced, will vigorously polymerize, decompose or condense, become self-reactive or otherwise undergo a violent chemical change under conditions of shock, pressure or temperature.

Unstable Reactive Gas (Class 2): Materials that readily undergo violent chemical change at elevated temperatures and pressures.

Unstable Reactive Gas (Class 3): Materials that in themselves are capable of detonation or explosive decomposition or explosive reaction but that require a strong initiating source or that must be heated under confinement before initiation.

Unstable Reactive Gas (Class 4): Materials that in themselves are readily capable of detonation or explosive decomposition or explosive reaction at normal temperature and pressure.

Use: To place a material into action, including solids, liquids and gases.

Valve Outlet Cap: A removable device that forms a gastight seal on the outlet to the control valve that is provided on a source containing a compressed gas or cryogenic fluid.

1. INDIVIDUAL CHEMICAL HYGIENE RESPONSIBILITIES

1.1 Department of Environmental Health and Safety (EHS)

A. Provides general laboratory safety training to employees.
B. Provides technical assistance to laboratory employee's regarding chemical handling, storage, use, and disposal.
C. Conducts exposure assessments upon request. Maintains environmental monitoring and employee exposure records. Notifies affected employees in writing of any monitoring results either individually or by posting results in an appropriate location accessible to employees. This information shall be distributed within five working days.
D. Archive each department's chemical inventory on an annual basis.
E. Conducts annual testing of chemical fume hoods and posts the testing results on each chemical fume hood in the department.
F. Conducts annual testing on eyewash and safety showers.
G. Conducts laboratory inspections/audits to ensure compliance with applicable regulations and standards.
H. Provides technical assistance regarding personal protective equipment and safety equipment.
I. Provides technical assistance to employees to ensure code compliance.

1.2 Dean and Department Chairperson

A. Assumes responsibility for departments engaged in the laboratory use of hazardous chemicals and appoints one or more CHO for each department. Contact information for the designated CHO must be shared and updated as needed with EHS.
B. Provides the CHO with the support necessary to implement and maintain their CHP.
C. Ensures that each department remains in compliance with the departmental and institutional CHP.
D. Provides budgetary arrangements to ensure the health and safety of employees.

1.3 Chemical Hygiene Officer (CHO)

A. Should assist Principal Investigator with the establishment of a laboratory-specific CHP that will provide a safe and healthy environment in which to teach and learn.
B. May create and revise safety rules and regulations.
C. Should monitor procurement, use, storage, and disposal of chemicals.
D. Should keep current of legal requirements concerning regulated substances.
E. Shall assist Laboratory Supervisors and Principal Investigators to develop precautions and maintain adequate facilities.

F. May conduct regular inspections of the laboratories, preparation rooms, and chemical storage rooms in the absence of the Laboratory Supervisor.
G. Shall maintain inspection, personnel training, and inventory records.
H. Shall attend Laboratory Safety, Hazardous Communication, and Hazardous Waste training annually and CHO training when offered.
I. Shall assist Principal Investigator to ensure that employees receive appropriate training and information regarding the chemical hazards in their work area. Training and information shall be provided at the time of an employee's initial assignment to a work area and prior to assignments involving new exposure situations.
J. Shall assemble a list of personnel that are required to receive the Hazardous Waste training.
    a. Supply Dean and Departmental Chair with a copy of assembled personnel list. The assembled personnel list of individuals required to complete the training should be updated twice per year within thirty days of the beginning of both the fall and spring semesters.
    b. At a minimum, on a quarterly basis the EHS list of completed training must be checked against the internal list of those that need training.
    c. Report deficiencies to Dean and Departmental Chair on a quarterly basis.
K. Should encourage laboratory employees to attend specialized training that is provided by the institution (i.e. first-aid training, fire extinguisher training, and compressed gas cylinder training).
L. Shall notify employees of the availability of medical attention under the following circumstances:
    a. Whenever an employee develops signs or symptoms associated with a hazardous chemical to which the employee may have been exposed in the laboratory.
    b. Where exposure monitoring reveals an exposure level routinely above the action level for an OSHA regulated substance for which there are exposure monitoring and medical surveillance requirements.
    c. Whenever a spill, leak, explosion, or other occurrence resulting in the likelihood of a hazardous exposure occurs, the employee may have a medical consultation to ascertain if a medical examination is warranted.
    d. If medical attention is necessary, the CHO provides the attending physician the identity of the hazardous substance to which the employee may have been exposed; a description of the conditions under which the exposure occurred; and the signs and symptoms that the employee may be experiencing.
M. Shall act as liaison between the department and EHS.
N. Should seek ways to improve chemical hygiene in laboratories.

1.4 Principal Investigator and Laboratory Supervisor

A. Shall establish a written laboratory-specific CHP.
B. Shall ensure that laboratory workers comply with the institutional, laboratory-specific, and departmental CHPs where applicable and do not operate equipment or handle hazardous chemicals without proper training and authorization.
C. Shall conduct regular inspections of the laboratory to ensure EHS requirements are being met.
D. Shall work with designated CHO to ensure hazardous waste training requirements are being met.
E. Shall communicate appropriate portions of the CHP to students in the work area.
F. Shall ensure that all laboratory workers at risk for exposures to hazardous substances are adequately informed about the work in the laboratory, its risks, and what to do if an accident occurs.
G. Shall always wear personal protective equipment that is compatible to the degree of hazard of the chemical.
H. Shall follow all pertinent safety rules when working in the laboratory to set an example.
I. Shall review laboratory procedures for potential safety problems before assigning to other laboratory workers.
J. Shall ensure that visitors follow the laboratory rules and assumes responsibility for the laboratory visitors.
K. Shall remain informed of current regulations and changes regarding the OSHA Laboratory standard.
L. Shall ensure that personal protective equipment is available and properly used by the laboratory employees and visitors.
M. Shall maintain and implement safe laboratory practices.

N. Shall monitor the facilities and the chemical fume hoods to ensure that they are maintained and function properly. Shall contact the appropriate person, as designated by the Department Chairperson, to report problems with the facilities or the chemical fume hoods.

1.5 Laboratory Worker and Employee

A. Shall read, understand, and follow the institutional, laboratory-specific, and departmental CHPs where applicable in addition to all safety rules and regulations that apply to the work area.
B. Shall plan and conduct each operation, laboratory class, or research project in accordance with the laboratory-specific CHP.
C. Shall practice good housekeeping in the laboratory or work area.
D. Shall notify the supervisor, principal investigator, and/or CHO of any hazardous conditions or unsafe work practices in the work area.
E. Shall use personal protective equipment as appropriate for each procedure that involves hazardous chemicals.
F. Shall immediately report any job-related illness or injury to the supervisor, principal investigator, and/or CHO.

2. GENERAL LABORATORY PROCEDURES

2.1 Basic Rules and Procedures

Note: The following information should be used for all laboratory work with chemicals but may vary. It is imperative that the lab occupants read and understand the SDS of the materials they will be using, paying close attention to appropriate procedures for exposure and spill response, prior to working with the material.

A. **Accidents and spills:**
Be familiar with these sections of the SDS prior to using a chemical. Know the procedures for documenting and reporting accidents. Know the locations of spill response materials and kits.
B. **Avoidance of "routine" exposure:** Develop and encourage safe habits. Avoid unnecessary exposure to chemicals by any route; do not smell or taste chemicals. Vent apparatus, which may discharge toxic chemicals (vacuum pumps, distillation columns, etc.) into local exhaust devices. Inspect gloves and test glove boxes before use. Avoid release of toxic substances in cold rooms and warm rooms, since these have contained recirculated atmospheres.
C. **Choice of chemicals:** Use only those chemicals for which the quality of the available ventilation system is appropriate. Avoid ordering in bulk. Order only the amount needed for research. Mix only enough that is necessary to perform the experiment.
D. **Eating, smoking, etc.:** Avoid eating, drinking, smoking, gum chewing, or application of cosmetics in areas where chemicals are present, including but not limited to laboratories, storage rooms, and refrigerators. Wash hands thoroughly then leave the laboratory area before conducting these activities.
E. **Equipment and glassware:** Handle and store laboratory glassware with care to avoid damage. Do not use damaged glassware. Use extra care with Dewar flasks and other evacuated glass apparatuses. Properly shield or wrap them to contain chemicals and fragments should implosion occur. Use equipment only for its designed purpose. Do not use glassware for consumption of food or beverages.
F. **Exiting:** Wash areas of exposed skin thoroughly with soap and water before leaving the laboratory area. Do not leave research unattended.
G. **Horseplay:** Avoid practical jokes or other behavior that might confuse, startle or distract another worker.
H. **Personal apparel:** Pull back and secure long hair and loose clothing. Wear appropriate foot wear at all times in the laboratory or storage areas.
I. **Personal housekeeping:** Keep the work area clean and uncluttered. Do not block laboratory safety equipment. Make sure all chemicals and equipment being used are properly labeled and stored. Clean up the work area upon completion of an operation or at the end of each day.
J. **Personal protection:**
    a. Eye protection: See Section 2.5.
    b. Protective clothing: See Section 2.5.
    c. Gloves: See Section 2.5 and Appendix A.
    d. Respiratory protection: See Section 2.5.
    e. Use any other protective and emergency apparel and equipment as deemed necessary by the SDS.

K. **Planning:** Seek information and advice about hazards. Plan appropriate protective procedures, and plan positioning of equipment before beginning any new operation.

L. **Unattended operations:** Leave lights on, place an appropriate sign on the door, and provide for containment of toxic substance in the event of failure of a utility service (such as cooling water) to an unattended operation. Leave contact information and estimated return time. Notify supervisor of scheduled unattended operations.

M. **Use of fume hood:** Use the fume hood for operations which might result in the release of toxic chemical vapors or dust. As a rule of thumb, use a fume hood or other local ventilation device when working with any appreciably volatile substance with a TLV of less than 50 ppm. Confirm adequate fume hood performance before use. Keep the fume hood closed at all times except when adjustments within the hood are being made. Materials should not be stored in fume hoods for extended periods of time. When in use, do not allow materials or equipment to block vents or air flow inside the fume hood. Leave the hood "on" when it is not in active use if toxic substances are stored in it or if it is uncertain whether adequate general laboratory ventilation will be maintained when it is "off".

N. **Vigilance:** Be alert to unsafe conditions and see that they are corrected when detected.

O. **Waste disposal:** Understand and maintain up-to-date training on waste disposal procedures. Deposit chemical waste in appropriately labeled receptacles and follow all other waste disposal procedures of the CHP. Do not pour down the drain: concentrated acids or bases; highly toxic, malodorous, or lachrymatory substances; or any substances which might interfere with the biological activity of waste water treatment plants, create fire or explosion hazards, cause structural damage or obstruct flow.

P. **Working alone:** Avoid working alone in a laboratory. Never work alone in a laboratory if the procedures being conducted are hazardous.

2.2 Prior Approval

A. The OSHA Laboratory Standard requires Chemical Hygiene Plans to include information on “the circumstances under which a particular laboratory operation, procedure or activity shall require prior approval”, including “provisions for additional employee protection for work with particularly hazardous substances” such as "select carcinogens," reproductive toxins, and substances which have a high degree of acute toxicity. Prior approval ensures that laboratory workers have received the proper training on the hazards of particularly hazardous substances or with new equipment, and that safety considerations have been taken into account BEFORE a new experiment begins.

1. **While EHS can provide assistance in identifying circumstances when there should be prior approval before implementation of a particular laboratory operation, the ultimate responsibility of establishing prior approval procedures lies with the Principal Investigator or laboratory supervisor**.
2. Principal Investigators or laboratory supervisors must identify operations or experiments that involve particularly hazardous substances (such as "select carcinogens," reproductive toxins, and substances which have a high degree of acute toxicity) and highly hazardous operations or equipment that require prior approval. They must establish the guidelines, procedures, and approval process that would be required. This information should be documented in the laboratory's or department's SOPs. Additionally, Principal Investigators and laboratory supervisors are strongly encouraged to have written documentation such as prior approval forms that are completed and signed by the laboratory worker, and signed off by the Principal Investigator or laboratory supervisor and kept on file.
3. Examples where Principal Investigators or laboratory supervisors should consider requiring their laboratory workers to obtain prior approval include:
    a. Experiments that require the use of particularly hazardous substances such as "select carcinogens," reproductive toxins, and substances that have a high degree of acute toxicity, highly toxic gases, cryogenic materials and other highly hazardous chemicals, highly reactive chemical mixtures, or experiments involving radioactive materials, high powered lasers, etc.
    b. Where a significant change is planned for the amount of chemicals to be used for a routine experiment such as an increase of 10% or greater in the quantity of chemicals normally used.
    c. When a new piece of equipment is brought into the lab that requires special training in addition to the normal training provided to laboratory workers.
    d. When a laboratory worker is planning on working alone on an experiment that involves highly hazardous chemicals or operations.

B. **Campus Prior Approval**

1. Some circumstances exist in which prior approval from a campus research related committee is required before beginning an operation or activity. These include:
   a. Research using live vertebrate animals – contact the WVU Animal Care and Use Committee at (304) 293-9368
   b. Recombinant DNA use – contact the Biosafety Committee at (304) 293-4029 or (304) 293-7157
   c. Use of Radioactive Materials – contact Radiation Safety at (304) 293-1554
   d. Use of Human Subjects – contact the Institutional Review Board and Human Subjects Research at (304) 293-1119

2.3 Particularly Hazardous Substances and Permissible Exposure Limits

A. For a list of Permissible Exposure Limits (PELs) for OSHA regulated substances, access the following annotated Z-Tables found at www.osha.gov.
   1. Air Contaminants: Table Z-1
   2. Chemicals: Table Z-2
   3. Mineral Dust: Table Z-3

B. Click here for OSHA's list of *Highly Hazardous Chemicals, Toxics, and Reactives*.

2.4 Chemical Procurement, Distribution, and Storage

A. **Procurement**

Before a substance is received, information on proper handling, storage, and disposal should be known to those who will be involved. No container should be accepted without an adequate identifying label.

B. **Stockrooms/storerooms**

Toxic substances should be segregated in a well-identified area with local exhaust ventilation. Chemicals which are highly toxic or other chemicals whose containers have been opened should be in unbreakable secondary containers. Stored chemicals should be examined periodically (at least annually) for replacement, expiration, deterioration, and container integrity. Stockrooms/storerooms should not be used as preparation or repackaging areas and should be controlled by one designated person.

C. **Distribution**

When chemicals are transferred by hand, the container should be carried in an outside container or bucket. Freight-only elevators should be used if possible.

D. **Laboratory storage**

Chemical storage amounts should be as small as practical. Storage on bench tops and in fume hoods is inadvisable. Exposure to heat or direct sunlight should be avoided. Chemical inventories should be conducted and regularly maintained. Expired chemicals or chemicals that have exceeded their usable lifetime should be disposed of properly.

2.5 Housekeeping, Maintenance and Inspections

A lab must be clear of slips, trips and fall hazards and have accessible aisles, correctly labeled containers, and cleared counter tops and work benches. It is important that the following be maintained for compliance of laws and for the safety of laboratory employees:

A. EHS will perform annual laboratory audits (informal inspections by CHO and lab personnel should be continual).
B. All laboratory occupants shall conduct good housekeeping procedures daily.
C. Laboratory personal protective equipment needs to be clean and accessible to all laboratory occupants.
D. Counter tops and work benches shall be clean, neat and orderly.
E. Hallways and stairways will not be used as storage areas.
F. Access to exits and emergency and laboratory safety equipment and utilities should never be blocked.
G. No materials shall be stored within the area of eighteen inches below the bottom of the deflector of the laboratory sprinklers. Combustible material such as boxes shall be kept to a minimum in the laboratory.
H. Label all chemical containers, including waste receptacles, with the contents and approximate composition. **Keep all containers closed.** Do not remove manufacturer's label.
I. Laboratory fume hoods shall not be used to store chemicals. Equipment should not block airflow in front of and within the fume hood. Fume hoods will be tested annually by EHS.
J. Each laboratory will have a spill kit to handle small non-hazardous spills.
K. Lab equipment shall be serviceable and in good condition.
L. Warning signs shall be posted for areas of special or unusual hazards.

2.6 Personal Protective Apparel and Equipment

A. Laboratory supervisors or CHOs shall designate areas, activities, and tasks requiring specific types of personal protective equipment. Protective equipment (especially respirators and gloves) shall not be worn in public areas in order to prevent the spread of contamination from laboratory areas and to avoid alarming other individuals in the facility when using public areas, such as elevators or restrooms.

B. **Eye Protection**

Eye protection is required for all personnel and any visitors where chemicals are stored or handled. Side shields on safety spectacles provide some protection against splashed chemicals or flying particles, but goggles or face shields are necessary when there is a greater than average danger of eye contact. A higher than average risk exists when working with highly reactive chemicals, concentrated corrosives, or with vacuum or pressurized glassware systems. Avoid use of contact lenses in the laboratory when possible. Inform supervisor when contacts must be worn to ensure appropriate safety precautions are taken.

C. **Protective Clothing**

Lab coats or lab aprons are strongly recommended for all laboratory occupants. Lab coats are required when working with select carcinogens, reproductive toxins, substances which have a high degree of acute toxicity, strong acids and bases, and any substance on the OSHA PEL list carrying a "skin" notation. Flame-retardant laboratory coats are recommended for any processes in which flammable or easily ignitable substances are handled. Avoid wearing synthetic clothing, which can catch fire easily or melt, when working with flammable substances. Bare feet, sandals, open-toed shoes, cloth shoes, and clogs are not allowed in any area in which chemicals are used or stored. Remove any protective clothing immediately when significantly contaminated.

D. **Gloves**

Gloves made of an appropriate material are required to protect the hands and arms from thermal burns, cuts, or chemical exposure that may result in absorption through the skin or reaction on the surface of the skin. Gloves are also required when working with particularly hazardous substances where possible transfer from hand to mouth must be avoided. Gloves maybe required in a laboratory to reduce sample contamination, but they may not provide chemical resistance. Specific gloves should be worn for hazard protection. Gloves should be carefully selected using guides from the manufacturers and based on SDS requirements. General selection guides are available; however, glove resistance to chemicals will vary with the manufacturer, model and thickness. Be informed prior to purchasing gloves for a particular use. Special gloves are needed when handling hot material, such as autoclaved items. Under no circumstances should household 'oven mitts' be used to handle hot containers. Gloves which are damaged to the point of having holes that expose skin are strictly forbidden. Special gloves are also needed when handling cryogenic material such as dry ice or liquid nitrogen. These gloves MUST BE DRY to avoid having the gloves adhere to skin once they become cold. See Appendix A for glove guide resources.

E. **Respiratory Protection**

Use appropriate respiratory equipment when air contaminant concentrations are not sufficiently restricted by engineering controls. Availability of respiratory protection for emergency situations may be required when working with chemicals that are highly toxic and highly volatile or gaseous. If an experimental protocol requires exposure above the action level that cannot be reduced, respiratory protection will be required. Exposure levels can be evaluated by contacting EHS. Always inspect respirators prior to use. All use of respiratory protective equipment is covered under the WVU Respiratory Protection Program**.**

2.7 Record Retention Responsibilities

A. **College or Department and Laboratory Occupant Responsibilities**

1. Copies of all personnel training records are maintained by individual colleges or departments. Hazardous Waste/Hazard Communication/Lab Safety Training records are maintained by the individual college.
2. Up-to-date chemical inventories are completed by laboratory occupants and submitted to the CHO.
3. The departmental CHP if applicable should be made available to laboratory occupants and maintained by the designee of the college for a length of time established by the college.

B. **CHO Responsibilities**

1. All accident report forms will be submitted to the CHO.
2. Completed and Up-to-date chemical inventories are maintained by the CHO.

C. **EHS Responsibilities**

1. Up-to-date chemical inventories are archived by EHS.
2. Medical Monitoring records will be retained by EHS and the employee's supervisor.

D. **WVU Occupational Medicine Responsibilities**
1. Medical records: retained by WVU Occupational Medicine

2.8 Signs and Labels

A. **Signs in the Laboratory**
1. Prominent signs of the following types should be posted in each laboratory:
   i. Signs identifying locations for safety showers, eyewash stations, other safety and first aid equipment, and exits
   ii. Alert signs located in areas or at equipment where special or unusual hazards exist

B. **Laboratory and Shop Doors**
1. To assist first responders it is important for information to be posted on laboratory doors. NFPA-704 diamond was designed to protect employees and emergency personnel. The 704 will contain the following information:
   i. Environmental Health and Safety office phone number
   ii. Principal Investigator (PI)/ Lab Supervisor's contact information, which includes, office phone, home phone and cell phone numbers.
   iii. CHO's office, home and cell phone number
   iv. Department Chair's office, home and cell phone numbers.
2. It is important to be able to contact these individuals, for the safety of all personnel directly involved in emergency response. **If lab occupancy changes or chemical contents of lab changes contact EHS immediately to post an updated 704.**
3. For additional information on sign requirements reference OSHA 29 CFR 1910.145.

C. **Refrigerators, Freezers, or Coolers**
1. Each refrigerator, freezer, or cooler shall be prominently marked to indicate whether it meets the requirements for safe storage of flammable liquids.
2. Refrigerators intended to contain food for consumption only should be clearly marked as such.

D. **Container Labels** (See OSHA 29 CFR 1910.1200 Appendix C for additional information.)
1. All containers of hazardous chemicals which could pose a physical or health hazard to an exposed employee must have a label attached. Labels on purchased hazardous chemicals must include:
   a. The product identifier used on the safety data sheet, which is the common name of the chemical (no abbreviations)
   b. The name, address and emergency phone number of the company responsible for the product
   c. An appropriate signal word, such as "danger" or "warning"; (Newer products shall have a signal word, hazard statement(s), pictogram(s), and precautionary statement(s).)
2. Most labels will provide additional safety information, which may include protective measures to be used when handling the material, clothing that should be worn, first aid instructions, storage information and procedures to follow in the event of a fire, leak or spill. Newer products shall have a hazard statement(s) and precautionary statement(s), and the use of the word "caution" may appear on older products. More information can be located on the SDS, which should be reviewed prior to use.
3. If a container is found with no label, report it to the supervisor. Report to the supervisor any labels that are torn or illegible so that the label can be replaced immediately. Existing labels on new containers of hazardous chemicals should not be removed or defaced. Labels of empty bottles of hazardous chemicals should be removed or defaced prior to disposal with the exception of acutely hazardous P-Listed waste. Bottles that contained acutely hazardous P-Listed waste should be disposed of as RCRA hazardous waste with the label intact.
4. Secondary containers for daily use and/or storing chemicals must be labeled with the product identifier and words, pictures, symbols, or combination thereof, which provide at least general information regarding the hazards of the chemicals. Portable secondary containers intended for immediate use must be marked with the product identifier or chemical name of the material as found on the SDS or on the original shipment container. It may be beneficial to protect labels on secondary containers with clear packing tape to prevent smearing.
5. Labels or other forms of warning must be legible, in English, and prominently displayed on the container, or readily available in the work area throughout each work shift. If employees speak other

languages, then information in the other languages may be added to the containers. The use of unmarked, portable containers of hazardous chemicals is not permitted. No exceptions will be granted.

6. Read the label and the SDS of newly purchased chemicals. The manufacturer may have added new hazard information or reformulated the product since the last purchase and thus altered the potential hazards faced while working with the product.
7. All employees involved in unpacking chemicals are responsible for inspecting each incoming container to ensure that it is labeled with the information outlined above. The principal investigator, department CHO, and/or laboratory supervisor should be notified of improperly labeled containers.

2.9 Training and Information

A. **Emergency and Personal Protection Training:**
   1. Every laboratory worker should know the location and proper use of available personal protective apparel and equipment.
   2. Some of the full-time personnel of the laboratory should be trained in the proper use of emergency equipment and procedures. Participation in such training, as well as, first aid instruction should be available to and encouraged for everyone.
   3. Laboratory-specific training should include:
      a. Location of SDSs
      b. Information pertaining to the PELs of chemicals used in the laboratory
      c. Signs and symptoms associated with possible exposures to substances used in the laboratory
      d. Methods and observations that may be used to detect the presence or release of hazardous chemicals (such as monitoring conducted by the employer, continuous monitoring devices, visual appearance or odor of hazardous chemicals when being released)
      e. The physical and health hazards of chemicals in the work area
      f. The measures employees can take to protect themselves from these hazards, including specific procedures the employer has implemented to protect employees from exposure to hazardous chemicals, such as appropriate work practices, emergency procedures, and personal protective equipment to be used
      g. Any other identified hazards specific to the laboratory

B. Laboratory workers must complete the required institutional training. Contact the CHO or EHS for clarification on what training is required.

C. The training and education program should be a regular, continual activity, occurring at minimum annually. Training shall be given and/or received in any instance in which procedures change or a significant laboratory event that calls for change occurs.

2.10 Waste Disposal

A. For proper disposal procedures for chemical waste:
   1. Refer to the WVU Waste Management SOP.
   2. Chemicals must be compatible with the container. Chemical compatibility charts and container compatibility charts are located in Appendix D.
   3. Submit the Hazardous Waste Disposal Form. Contact the CHO or EHS with questions regarding the form or waste disposal procedures. Appendix E contains instructions for completing the waste disposal form.

B. If the recommended disposal procedures include treatment of waste, EHS should be contacted as WVU is not permitted to treat waste.

2.11 Accidents, Spills, Personal Contamination and Injury

A. **Initial Steps and Available Resources**
   1. Refer to the Safety Data Sheet for chemical hazards, spill and clean up instructions, and first aid and fire extinguishing measures.
   2. Initial steps to consider:
      i. Stop the source of the spill if it is safe to do so
      ii. Prevent the spill from spreading further
      iii. Determine the necessary additional resources needed or if clean up can be safely accomplished by laboratory personnel. (i.e., Call 911 for Fire Department and Hazardous Materials Responders, call EHS for assistance, notify the supervisor and continue clean-up operations, etc.)
   3. Refer to the Waste Management SOP for instructions on how to dispose of the collected spill waste.

B. **General Information**
   1. Before handling chemicals, know the locations of the nearest safety shower and eye wash fountain.
   2. Immediately report all incidents and injuries to your supervisor, Principal Investigator, and/or CHO.
   3. If an individual is contaminated or exposed to a hazardous material in your laboratory, do what is necessary to protect their life and health as well as your own. Determine what the individual was exposed to, and locate the SDS to determine first aid measures and to provide the information for emergency responders and medical personnel. Get medical attention promptly by dialing 9-911 from a campus phone.
   4. Do not move an injured person unless they are in further danger (from inhalation or skin exposure).
   5. A blanket should be used immediately to protect the victim from shock and exposure.
   6. Post a sign to prevent others from entering the contaminated area.
   7. Inform others in the vicinity of a spill or leak.

C. **Emergency Phone Numbers:**
   1. **FOR ALL MEDICAL EMERGENCIES CALL 911**
   2. University Police (UPD) – Main Campus 304-293-2677 (COPS)
   3. University Police (non-emergency) 304-293-4357 (HELP)
   4. Environmental Health and Safety (after normal business hours call UPD) 304-293-3792

3. LABORATORY FACILITIES

3.1 Design

A. The laboratory facility will have an appropriate general ventilation system to avoid intake of contaminated air.
B. The stockrooms and storerooms will be well ventilated.
C. The laboratory will have available working fume hoods and laboratory sinks if needed.
D. Other safety equipment in the laboratory will include fire extinguishers, safety showers, eyewash fountains and first aid kits.
E. Any changes to the laboratory design are not permitted without prior approval from the Department Chair, the CHO and EHS.
F. General air flow should not be turbulent and should be relatively uniform throughout the laboratory with no high velocity or static areas. Airflow into and within the hood should not be excessively turbulent (above 150 fpm). Hood face velocity should be adequate (typically 60-100 fpm).

3.2 Maintenance and Inspection

A. Certain chemical laboratory fume hoods, safety showers, and eye wash stations are inspected annually by EHS. The testing of proper flow rates of Laminar Flow Hoods, Biological Safety Cabinets, and all fume hoods contained within positive pressure Clean Rooms are the responsibility of the department. Refer to the Laboratory Fume Hood/Canopy Use and Maintenance Program for more information.
B. Modifications to the laboratory fume hood ventilation systems are prohibited without EHS consultation and approval. Fume hoods are manufactured to meet specifications. Altering them in any way may cause hood failure and affect the building ventilation system. If research requires the addition of extra equipment that exhausts, then special ventilation maybe required. If special equipment is required contact the CHO and EHS for approval.
C. Fume hoods that undergo maintenance should be re-inspected by EHS. The individual responsible for the laboratory should contact EHS to request a fume hood re-inspection.
D. Designated laboratory personnel should bump test safety showers and eye wash fountains weekly.
E. Additional laboratory equipment (such as, deionized water systems, autoclaves, etc.) should be inspected on a regular basis as defined by the manufacturer. Incinerators have permit requirements and are required to be inspected regularly. Contact EHS for laboratory specific guidelines.

3.3 Usage

A. The work conducted and its scale must be appropriate to the physical facilities available and especially to the quality of ventilation.
B. Users must ensure proper operation of the fume hood before each use by performing the following maintenance checks:
   1. Inspect the physical condition of the hood interior, sash and visible duct work;
   2. Check the fume hood sash for ease of operation;

3. Test the air-flow monitoring device (if present), which is located on the front of the fume hood;
4. Check mechanical services inside the fume hood and under the canopy (i.e. water, steam, compressed air, gas, vacuum, etc.)

C. In the event of fume hood or canopy malfunction, do the following:
1. Discontinue use of the fume hood and post a sign stating, "OUT OF SERVICE. DO NOT USE."
2. Inform the Building Supervisor or CHO
3. Notify Facilities Management (293-HELP). Be sure to include an in-depth description of the malfunction.
4. Once the fume hood has been repaired, submit an EHS Service Request Form to request retesting.
5. If the fume hood or canopy is not repaired in a timely manner, then submit an EHS Service Request Form stating such.

D. Prudent Work Practices
1. All work involving hazardous or odorous chemicals should be performed in a fume hood.
2. All equipment and materials should be placed at least 6 inches back from the face (or front) of the hood; these items should not obstruct the movement of air into the hood.
3. Do not place your head into the fume hood when contaminants are present.
4. The sash should be used to minimize the size of the working aperture and to act as a safety screen; one should use an appropriate barricade if there is a chance of an explosion. The proper working height of the sash is 18 inches. Hoods are marked signifying the safest working range.
5. The fume hood should not be used as a storage area or overloaded with unnecessary equipment and materials. The presence of these materials can seriously affect the air flow in the hood. Storage underneath the fume hood or in approved safety storage cabinets is preferred. All chemical product and waste containers should have caps on tightly.
6. The fume hood should never be used for long-term storage of hazardous chemical wastes. To have wastes removed follow the directions that are posted online when filling out the Hazardous Waste Disposal Form.
7. Electrical receptacles or other ignition sources should not be placed inside the fume hood if flammable liquids or gases may be present. Review the SDS for all chemicals in use to know if an experiment involves flammable liquids or gases. Electrical connections should be made outside the hood and no permanent electrical receptacles should be permitted in the hood.
8. Foot traffic past the face of the hood should be minimized. Air flow caused by such traffic can cause turbulence and disrupt the air flow in the hood which can cause gases and vapors to be drawn out of the hood into the room. Cross drafts from windows and doors in close proximity to fume hoods will also affect the stability of the air flow within the fume hood.
9. Keep the interior of the fume hood clean and tidy to protect laboratory workers.
10. Do not conduct work in a malfunctioning fume hood. If the alarm is triggered contact the laboratory CHO and/or PI. A work-request must be submitted to Facilities Management. Please do not mute the alarm and continue working.
11. Wear safety glasses/goggles or face shield, gloves, aprons and any other PPE required for materials being used. Information for PPE can be found in the SDS for the chemicals in use.

4. ENVIRONMENTAL MONITORING AND MEDICAL SURVEILLANCE PROGRAM

4.1 Environmental Monitoring

A. Regular instrumental monitoring of airborne concentration is not usually justified or practical in most laboratories but it may be appropriate when fume hoods or other ventilation devices are being tested or redesigned or when a highly toxic substance is being stored or used regularly. Exposure monitoring can be conducted by EHS. To request an evaluation, click on Service Request at ehs.wvu.edu.

B. EHS will conduct annual ventilation testing on certain laboratory fume hoods as stated in Section 3.2 of this document.

4.2 Medical Surveillance Program

A. The WVU Medical Surveillance Program applies to
1. WVU employees and student employees who may come in contact with chemical or physical hazards, including noise, radiation, biological or animal related hazards.

2. Job classifications that require "fitness-for-duty" examinations, such as positions or work duties that impact public safety or require safety sensitive duties.
3. Employees in order to measure the effectiveness of engineering and administrative controls. Testing may involve biological surveillance as indicated by WVU Occupational Medicine.

B. A medical examination and subsequent medical monitoring specifically for laboratory employees who are exposed to hazardous chemicals will occur for one of the following reasons:
1. If the employee develops signs and symptoms of a potential exposure to a hazardous chemical in a laboratory.
2. When an employee has been exposed to a hazardous chemical over the Action Level or Permissible Exposure Level (PEL).
3. In the event the employee was involved in a significant laboratory spill, leak, explosion, or other occurrences resulting in the likelihood of exposure to a hazardous chemical.

C. **In the event of a work related medical emergency**, the employee must immediately notify his or her supervisor. The supervisor must complete, print, sign and fax/mail an Employee Injury/Incident Report to EHS within 24 hours of the incident. Appropriate contact information and phone numbers can be found on the form.

D. Employees should work with EHS throughout the course of a project to evaluate work processes and action levels for OSHA regulated substances to minimize potential exposure concerns.

E. Employee records will be maintained for the length of employment plus 30 years. To access these records, employees or their designees can contact the medical provider.

F. Direct all other medical surveillance questions to EHS.

5. COMPRESSED GAS CYLINDER SAFETY

5.1 General Requirements

The following are general requirements for compressed gas and cryogenic fluid production, handling, storage and use.

A. **Emergency Plan**

1. An emergency plan shall be prepared and updated wherever compressed gases or cryogenic fluids are produced, handled, stored or used where required by the Authority Having Jurisdiction (AHJ). Potential authorities having jurisdiction include the West Virginia State Fire Marshal's Office, The West Virginia Division of Labor, the West Virginia Department of Environmental Protection and the City of Morgantown.
2. The plan shall be available for inspection by the AHJ upon reasonable notice and shall include the following information:
   a. The type of emergency equipment available and its location.
   b. A brief description of any testing or maintenance programs for the available emergency equipment.
   c. An indication that hazard identification labeling is provided for each storage area.
   d. The location of posted emergency procedures.
   e. A Safety Data Sheet (SDS) for each compressed gas or cryogenic fluid stored or used on the site.
   f. A list of personnel who are designated and trained to be liaison personnel for the fire department and who are responsible for the following:
      i. Aid the emergency responders in pre-emergency planning
      ii. Identify the location of the compressed gases and cryogenic fluids
      iii. Access safety data sheets
      iv. Know site emergency procedures
   g. A list of the types and quantities of compressed gases and cryogenic fluids found within the facility.

B. **Safety Data Sheets**

1. Safety Data Sheets shall be readily available on the premises for hazardous materials regulated by this code.

C. **Release of Compressed Gases and Cryogenic Fluids**

1. Prohibited Releases
   a. Compressed gases and cryogenic fluids shall not be released into a sewer, storm drain, ditch, drainage canal, lake, river or tidal waterway; upon the grounds, sidewalk, street or highway; or into the atmosphere unless such release is permitted by the following:

i. Federal, state or local governing regulations.
ii. Permits or the jurisdictional air quality management board.
iii. National Pollutant Discharge Elimination System Permit.
iv. Waste discharge requirements established by the jurisdictional water quality control board.
v. Local sewer pretreatment requirements for publicly owned treatment works.

b. Provisions shall be made for controlling and mitigating unauthorized discharges. Accurate records of unauthorized discharges of hazardous materials shall be kept. The fire department shall be notified immediately or in accordance with approved emergency procedures when unauthorized discharge becomes reportable under state, federal or local regulations.

2. Responsibility for Cleanup of Unauthorized Discharges
   a. The person, firm or corporation responsible for an unauthorized discharge shall institute and complete all actions necessary to remedy the effects of such unauthorized discharge, whether sudden or gradual at no cost to the jurisdiction.
   b. When deemed necessary by the AHJ, cleanup of an unauthorized discharge shall be permitted to be initiated by the fire department or by an authorized individual or firm and costs associated with such cleanup shall be borne by the owner, operator or other person responsible for the unauthorized discharge.

D. **Personnel Training**
1. Persons responsible for the operation or utilization of areas in which hazardous materials are stored, dispensed, handled or used shall be familiar with the chemical nature of the materials and the appropriate mitigating actions necessary in the event of fire, leak or spill.
2. Persons responsible for the operation or utilization of areas in which hazardous materials are stored, dispensed, handled or used should attend training upon initial employment, when new hazards are determined, and/or when a deficiency of performance or unsafe behavior has been identified.

E. **Fire Department Liaison**
1. Responsible persons shall be designated and trained to be liaison personnel for the fire department.
2. Liaison personnel shall aid the fire department in planning emergency responses and identification of the locations where compressed gases or cryogenic fluids are located and shall have access to Safety Data Sheets and be knowledgeable in the site emergency response procedures.

F. **Ignition Source Control**
1. Smoking shall be prohibited in the following locations:
   a. Within 25 feet of outdoor storage or dispensing areas.
   b. In rooms or areas where compressed gases or cryogenic fluids are stored, dispensed or used in open systems in amounts requiring a permit in accordance with this code.
2. Open flames and high-temperature devices shall not be used in a manner that creates a hazardous condition.
3. Energy-consuming equipment shall be listed for use with the hazardous materials stored or used.

G. **Signs**
1. Requirements
   a. Signs shall be durable, and the size, color and lettering of signs shall be in accordance with nationally recognized standards.
   b. Signs shall be in English as the primary language or in symbols allowed by this standard.
   c. Signs shall not be obscured or removed.
2. Hazard Identification Signs
   a. Visible hazard identification signs in accordance with NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, shall be placed on the following, except where the AHJ has received a hazardous materials inventory statement in accordance with this code and the omission of the signs is consistent with safety:
      i. Stationary aboveground tanks
      ii. Stationary aboveground containers
      iii. At entrances to locations where hazardous materials are stored, dispensed, used or handle.
      iv. At other entrances and locations designated by the AHJ.
   b. The authority having jurisdiction shall be permitted to waive this requirement where consistent with safety.

3. Identification of Containers, Cartons and Packages
    a. Individual containers, cartons or packages shall be conspicuously marked or labeled in accordance with nationally recognized standards.
4. Identification of Gas Rooms and Gas Cabinets
    a. Gas rooms or gas cabinets containing compressed gases shall be conspicuously labeled as follows: **COMPRESSED GAS.**
    b. Additional signs at areas of use or storage should notify occupants of the compressed gases present by name.
5. No Smoking Signs
    a. Signs prohibiting smoking shall be provided for an entire site or building or in the following locations:
        i. In rooms or areas where toxic, highly toxic, corrosive, unstable reactive, flammable, oxidizing or pyrophoric gases are stored or dispensed or used in open systems.
        ii. Within 25 feet of outdoor storage, dispensing or open use areas.
        iii. In areas containing open flames.

5.2 Classification of Hazards

A. **Pure Gases**

1. Hazardous materials shall be classified according to hazard categories as follows:
    a. Physical Hazards, which shall include the following:
        i. Flammable gas
        ii. Nonflammable gas
        iii. Oxidizing gas
        iv. Pyrophoric gas
        v. Unstable reactive gas (Class 3 or Class 4)
        vi. Unstable reactive gas (Class 2 or Class 3)
    b. Health hazards, which shall include the following:
        i. Corrosive gas
        ii. Cryogenic fluid
        iii. Highly toxic gas
        iv. Toxic gas
        v. Irritant gas

B. **Other Hazards**

1. Although it is possible that there are other known hazards, the classification of such gases is not within the scope of this standard and they shall be handled, stored or used as an "other gas".

C. **Mixtures**

1. Mixtures shall be classified in accordance with the hazards of the mixture as a whole.

D. **Toxicity**

1. The toxicity of gas mixtures shall be classified in accordance with CGA P-20, *Standard for the Classification of Toxic Gas Mixtures* or by testing in accordance with the requirements of OSHA 29 CFR 1910.1000 or DOT 49 CFR 173 or ISO 10298, *Determination of Toxicity of a Gas or Gas Mixture*.

E. **Flammability of Gas Mixtures**

1. For gas mixtures other than those containing ammonia and nonflammable gases, flammability of a gas mixture shall be classified in accordance with CGA P-23, *Standard for Categorizing Gas Mixtures Containing Flammable and Nonflammable Components*, or by physical testing in accordance with the requirements of ASTM E 681-01, *Standard Test Method for Concentration Limits of Flammability of Chemicals (Vapors and Gases*), or ISO 10156, *Gases and gas mixtures – Determination of fire potential and oxidizing ability for the selection of cylinder valve outlets.*

F. **Corrosive or Unstable Gases**

1. Cylinders of corrosive or unstable gases should be returned to the supplier when the expiration date of the maximum recommended retention period has been reached. Examples of such corrosive or unstable gases include the following:
    a. Acid and alkaline gases
    b. Gases subject to autopolymerization
    c. Gases subject to explosive decomposition

2. Cylinders of hydrogen fluoride and hydrogen bromide should be returned to the supplier within 2 years of the shipping date.
3. Cylinders not in active use should be removed from the laboratory work areas to a proper storage facility, as described in CGA Pamphlet P-1, *Safe Handling of Compressed Gases in Containers*. In the absence of a maximum recommended retention time, a 36-month interval should be used.

G. **Maximum Allowable Quantities**

1. The maximum allowable quantity of gases per control area shall be in accordance with **Table One.** The definitions for the High Hazard Protection Levels 1-5 can be found under Protection Level in the Definitions section.

Table One: Maximum Allowable Quantity (MAQ) of Hazardous Materials per Control Area

			Storage			Use – Closed Systems			Use – Open Systems	
Material	**Class**	**High Hazard Protect-ion Level**	**Solid Pounds**	**Liquid Gallons**	**Gas scf (lb)**	**Solid Pounds**	**Liquid Gallons**	**Gas scf (lb)**	**Solid Pounds**	**Liquid Gallons**
Cryogenic Fluid	Flammable	2	NA	45	NA	NA	45	NA	NA	45
	Oxidizing	3	NA	45	NA	NA	45	NA	NA	45
	Inert	NA	NA	NL	NA	NA	NL	NA	NA	NL
Flammable, gas	Gaseous	2	NA	NA	1000	NA	NA	1000	NA	NA
	Liquefied	2	NA	NA	(150)	NA	NA	(150)	NA	NA
	LP	2	NA	NA	(300)	NA	NA	(300)	NA	NA
Inert gas	Gaseous	NA	NA	NA	NL	NA	NA	NL	NA	NA
	Liquefied	NA	NA	NA	NL	NA	NA	NL	NA	NA
Oxidizing gas	Gaseous	3	NA	NA	1500	NA	NA	1500	NA	NA
	Liquefied	3	NA	NA	(1500)	NA	NA	(150)	NA	NA
Pyrophoric gas	Gaseous	2	NA	NA	50	NA	NA	50	NA	NA
	Liquefied	2	NA	NA	(4)	NA	NA	(4)	NA	NA
Unstable (reactive) gas	Gaseous									
	4 or 3 detonable	1	NA	NA	10	NA	NA	10	NA	NA
	3 nondetonable	2	NA	NA	50	NA	NA	50	NA	NA
	2	3	NA	NA	750	NA	NA	750	NA	NA
	1	NA	NA	NA	NL	NA	NA	NL	NA	NA
Unstable (reactive) gas	Liquiefied									
	4 or 3 detonable	1	NA	NA	(1)	NA	NA	(1)	NA	NA
	3 nondetonable	2	NA	NA	(2)	NA	NA	(2)	NA	NA
	2	3	NA	NA	(150)	NA	NA	(150)	NA	NA
	1	NA	NA	NA	NL	NA	NA	NL	NA	NA
Corrosive gas	Gaseous	4	NA	NA	810	NA	NA	810	NA	NA
	Liquefied		NA	NA	(150)	NA	NA	(150)	NA	NA
Highly toxic gas	Gaseous	4	NA	NA	20	NA	NA	20	NA	NA
	Liquefied		NA	NA	(4)	NA	NA	(4)	NA	NA
Toxic gas	Gaseous	4	NA	NA	810	NA	NA	810	NA	NA
	Liquefied		NA	NA	(150)	NA	NA	(150)	NA	NA

NA: Not applicable within the context of NFPA 55 (refer to the applicable building or fire code for additional information on these materials).
NL: Not limited in quantity.

Notes:
(1) For use of control areas, see Section 6.2.
(2) Table values in parentheses or brackets correspond to the unit name in parentheses or brackets at the top of the column.
(3) The aggregate quantity in use and storage is not permitted to exceed the quantity listed for storage. In addition, quantities in specific occupancies are not permitted to exceed the limits in the building code.
[a]Measured at NTP [70°F (20°C) and 14.7 psi (101.3kPa)].
[b]None allowed in unsprinklered buildings unless stored or used in gas rooms or in approved gas cabinets or exhausted enclosures, as specified in this code.
[c]With pressure-relief devices for stationary or portable containers vented directly outdoors or to an exhaust hood.
[d]Quantities are permitted to be increased 100 percent where stored or used in approved cabinets, gas cabinets, exhausted enclosures, gas rooms, as appropriate for the material stored. Where Footnote e also applies, the increase for the quantities in both footnotes is permitted to be applied accumulatively.
[e]Maximum quantities are permitted to be increased 100 percent in buildings equipped throughout with an automatic sprinkler system in accordance with NFPA 13. Where Footnote d also applies, the increase for the quantities in both footnotes is permitted to be applied accumulatively.
[f]Flammable gases in the fuel tanks of mobile equipment or vehicles are permitted to exceed the MAQ where the equipment is stored and operated in accordance with the applicable fire code.
[g]See NFPA 58 for requirements for liquefied petroleum gas (LP-Gas). LP-Gas is not within the scope of NFPA 55.
[h]Additional storage locations are required to be separated by a minimum of 300 ft (92 m)
[i]In mercantile occupancies, storage of LP-Gas is limited to a maximum of 200 lb (91 kg) in nominal 1 lb (0.45 kg) LP-Gas containers.
[j]Permitted only in buildings equipped throughout with an automatic sprinkler system in accordance with NFPA 13.
[k]Allowed only where stored or used in gas rooms or in approved gas cabinets or exhausted enclosures, as specified in this code.

5.3 Building Related Controls

A. **Cylinder Location/Separation**
   1. A second means of access to an exit shall be provided from a laboratory work area should a compressed gas cylinder larger than lecture bottle size [approximately 5 cm x 33 cm (2 in. x 13 in.)] be located so that it could prevent safe egress in the event of an accidental release of cylinder contents.
   2. Where possible and safe, compressed gas cylinders should be stored away from all laboratory exits.
   3. Control areas shall be separated from each other by not less than a 1-hour fire-resistive occupancy separation.

B. **Flammable and Oxidizing Gases**
   1. Flammable and Oxidizing gases shall not be stored or used in occupancies other than storage or industrial.
   2. Containers, cylinders or tanks not exceeding 250 ft^3 content at normal temperature and pressure and used for maintenance purposes, patient care or operation of equipment shall be permitted.

C. **Toxic and Highly Toxic Compressed Gases**
   2. Except for containers or cylinders not exceeding 20 ft^3 content at normal temperature and pressure stored or used within gas cabinets or exhausted enclosures of educational occupancies, toxic or highly toxic compressed gases shall not be stored or used in other than industrial and storage occupancies.

D. **Gas Rooms**
   1. Gas rooms shall be operated at a negative pressure in relationship to the surrounding area. Gas rooms shall be provided with an exhaust ventilation system.
   2. Gas rooms shall be separated from other occupancies by a minimum of 1-hour fire resistance.
   3. The function of compressed gas rooms shall be limited to storage and use of compressed gases and associated equipment and supplies.
   4. Lighting by natural or artificial means shall be provided.

E. **Shelving**
   1. Shelves used for the storage of cylinders, containers and tanks shall be of noncombustible construction and designed to support the weight of materials stored.
   2. In seismically active areas, shelves and containers shall be secured from overturning.

F. **Ventilation**
   1. Indoor Storage
      a. Indoor storage and use areas and storage buildings for compressed gases and cryogenic fluids shall be provided with mechanical exhaust ventilation or natural ventilation, where natural ventilation can be shown to be acceptable for the materials stored.
   2. Vent Pipe Termination
      a. The termination point for piped vent systems serving cylinders, containers, tanks and gas systems used for the purpose of operational or emergency venting shall be located to prevent impingement

exposure on the system served and to minimize the effects of high temperature thermal radiation or the effects of contact with gas from the escaping plume to the supply system, personnel, adjacent structures and ignition sources.

3. Mechanical Exhaust Ventilation
    a. Where mechanical exhaust ventilation is provided, the system shall be operational during the time the building space is occupied.
    b. Mechanical ventilation shall be at a rate of not less than 1 ft^3/minute/ft^2 of floor area over the area of the storage or use.
    c. Systems shall operate continuously unless an alternate design is approved by the code official.
    d. Where powered ventilation is provided, a manual shutoff switch shall be provided outside of the room in a position adjacent to the principal access door to the room or in an approved location.
    e. The switch shall be the break glass or equivalent type and shall be labeled as follows: WARNING: VENTILATION SYSTEM EMERGENCY SHUTOFF
4. Inlets to the Exhaust System
    a. The exhaust ventilation system design shall take into account the density of the potential gases released.
    b. For gases that are heavier than air, exhaust shall be taken from a point within 12 inches of the floor.
    c. For gases that are lighter than air, exhaust shall be taken from a point 12 inches from the ceiling.
    d. The location of both the exhaust and inlet openings shall be designed to provide air movement across all portions of the floor or room to prevent the accumulation of vapors.
    e. Exhaust ventilation shall not be re-circulated within the room or building if the cylinders, containers or tanks stored are capable of releasing hazardous gases.
5. Ventilation Discharge
    a. Ventilation systems shall discharge a minimum of 50 feet from intakes of air handling systems, air-conditioning equipment and air compressors.
6. Air Intakes
    a. Storage and use of compressed gases shall be located not less than 50 feet from air intakes.
7. Gas Cabinets
    a. Where a gas cabinet is required, is used to provide separation of gas hazards or is used to increase the threshold quantity for a gas requiring special provisions, the gas cabinet shall meet the following standards.
    b. The gas cabinet shall be constructed of not less than 2.46mm (12 gauge) steel.
    c. The gas cabinet shall be provided with self-closing limited access ports or noncombustible windows to give access to equipment controls.
    d. The gas cabinet shall be provided with self-closing doors.
8. Ventilation Requirements
    a. The gas cabinet shall be provided with an exhaust ventilation system designed to operate at a negative pressure relative to the surrounding area.
    b. Where toxic; highly toxic; pyrophoric; unstable reactive Class 3 or Class 4; or Corrosive gases are contained, the velocity at the face of access ports or windows, with the access port or window open, shall not be less than 200 feet/minute average, with not less than 150 feet/minute at any single point.
    c. Gas cabinets used to contain toxic, highly toxic or pyrophoric gases shall be internally sprinklered.
    d. Gas cabinets shall not contain more than three cylinders, tanks or containers.
    e. Incompatible gases shall be stored or used within separate gas cabinets.

5.4 Compressed Gases General Information

A. **Safety Tips**

1. General Hazards
    a. Thoroughly know the hazards of the gas in use. All compressed gases have the pressure hazard, but a gas can also have more hazards; gases can be toxic, corrosive, flammable, asphyxiating, oxidizing, pyrophoric, and/or reactive. All these factors can impact the design of the system and how the gases are utilized.
2. Eye Protection

a. Always wear eye protection when working on or near compressed gas systems. Do not allow others to enter a compressed gas cylinder storage area or where compressed gases are in use without proper eye protection.

3. Training
   a. Ensure all individuals responsible for operation or utilization of compressed gases are appropriately trained and knowledgeable in the dangers of pressure, the chemical properties of the gases in use, and the proper Compressed Gas Association (CGA) compressed gas fittings and connections.
4. Cylinder Identification
   a. Do not use a compressed gas cylinder that is not clearly marked or labeled with the cylinder's contents. Reject any cylinder that is unmarked or has conflicting markings or labels. Never rely on the color of the cylinder to identify the contents. If there is any conflict or doubt concerning the contents, do not use the cylinder. Return it to the vendor.
5. Cylinder Content
   a. Be certain that the content of the cylinder is the correct product for use in the system to which it is being connected.
6. Regulator Use
   a. Never use a compressed gas cylinder without a pressure-reducing regulator or device that will safely reduce the cylinder pressure to the desired pressure of the system. Only use regulators that have both a high-pressure gauge and a low-pressure gauge. This allows for the monitoring of both the pressure in the compressed gas cylinder and the pressure in the system.
7. Pressure Gauge Use
   a. As per ANSI B 40.1, *Pressure Gauges and Gauge Attachments*, never use a gauge above 75 percent of its maximum face reading. For example, a 20,700 kPa (3,000 psi) system should use at least 27,600 kPa (4,000 psi) gauges. If the system can achieve a maximum pressure of 517 kPa (75 psi), the gauge monitoring system should be at least 690 kPa (100 psi). (Immediately replace any gauge in which the pointer does not go back to its zero point when pressure is removed.)
8. Valves
   a. Be sure the valve on the compressed gas cylinder and the pressure-reducing regulator in use have the proper CGA connections for the pure gas (CGA V-1) or gas mixture (CGA V-7) in use. Never use an adaptor between a cylinder and a pressure-reducing regulator.
9. Proper Connection
   a. Be certain that the CGA connection(s) on the cylinder and the pressure-reducing regulator fit together properly without being too loose or too tight. Proper connections will go together smoothly. Never use excessive force to connect a CGA connection. Never use an aid, such as a pipe dope or Teflon® tape, to connect a regulator to a cylinder.
10. Connections
    a. Be certain that the pressure-reducing regulator in use is compatible with the gas, and be certain that it is rated and marked for the maximum pressure rating of the CGA connection on the compressed gas cylinder valve being attached to it. All compressed gas cylinder connections can be found listed with their recommended gases and the maximum allowed pressures in CGA/ANSI V-1, *Standard for Compressed Gas Cylinder Valve Outlet and Inlet Connections*.
11. Regulator Compatibility
    a. Never replace the CGA connection that the regulator manufacturer has put on a regulator with one for a different gas service. Only the regulator manufacturer or trained service representative know the gas compatibility of the regulator's internal design and can properly reclean the regulator.
12. Procedures
    a. After attaching a pressure-reducing regulator to a compressed gas cylinder, do the following:
       i. Turn the regulator's adjustment screw out (counterclockwise) until it feels loose.
       ii. Stand behind the cylinder with the valve outlet facing away from you.
       iii. Observe the high-pressure gauge on the regulator from an angle; do not pressurize a gauge while looking directly at the glass or plastic faceplate.
       iv. Open the valve handle on the compressed gas cylinder slowly, until one can hear the space between the cylinder valve gently fill the gas. (One can also watch the pressure rise on the

high-pressure gauge. If the regulator is properly adjusted, then no gas should flow out of the regulator or pressure rise on the low-pressure gauge.

v. Ensure purity of a nontoxic, nonflammable gas by shutting off the cylinder valve and gently cracking the CGA connection at the cylinder valve. (Generally, three pressurizations with venting will ensure the interior of the connection has a clean, representative sample of the gas in the compressed gas cylinder. For toxic or flammable gases, a special venting regulator can be purchased to safely vent to a fume hood or vented gas cabinet.

vi. When ready to use the compressed gas cylinder, fully open the cylinder valve until it stops. Then, close it one-quarter turn. (A fully open valve that has no play in it can confuse a person who is checking to see if it is open. Many accidents have been recorded by people trying to open a previously fully opened valve by using a large wrench.)

vii. Use the following practices on acetylene cylinders to allow quick closing of the valve in the event of an emergency:
    1. Open acetylene cylinder valves no more than one and one-half turns.
    2. Leave the wrench on the valve spindle when the cylinder is being used, if the acetylene cylinder has a T-wrench instead of a hand-wheel valve.

13. Pressure Relief
    a. Make sure any system being pressurized (piping, manifolds, containers, etc.) that can be isolated or closed off has its own pressure-relief device. If is the user's responsibility to see that the system has proper pressure-relief device(s) built into it. Do not rely on the relief device on the compressed gas cylinder's regulator; it is not designed to protect downstream systems. This is very critical when cryogenic liquids are used. Pressure-relief discharge points should be vented to safe locations (not directed toward people or routed to safe locations for hazardous gases.)
14. Cylinders Not in Use
    a. Shut off cylinders that are not in use. Always have a cylinder cap on any cylinder that is being stored or is not in use.
15. Backflow Precautions
    a. Use backflow check valves where flammable and oxidizing gases are connected to a common piece of equipment or where low- and high-pressure gases are connected to a common set of piping. Do not rely on a closed valve to prevent backflow.
16. Pressure Relief
    a. The relief device on a cylinder of liquefied flammable gas (generally found on the cylinder valve) always should be in direct contact (communication) with the vapor space of the cylinder in both use and storage. Never lay a cylinder of liquefied flammable gas on its side unless it is so designed (and so marked) to allow that positioning, as in the case of propane cylinders for forklift trucks.
17. Protection of Cylinders in Use
    a. Cylinders in use should be secured by a holder or device specifically designed to secure a cylinder. Never stand a single cylinder in an open area unsecured. Always protect cylinders from danger or overhead hazards, high temperatures, and other sources of damage, such as vehicle traffic.
18. Moving Cylinders
    a. Always use a cylinder cart to move large cylinders or specially designed cylinder holders to carry small cylinders. Never pick up a cylinder by its cap.
19. Refilling
    a. Never refill a cylinder or use a cylinder for storing any material. If gas is accidentally forced back or sucked back into a cylinder, mark the cylinder well and inform the gas supplier. (Almost all recent deaths involving compressed gas cylinders occurred as users were putting gas back into cylinders and fillers at the compressed gas plants.)
20. Asphyxiation
    a. Possibly the greatest hazard to a user of compressed gases – and especially users of cryogenic fluids – is asphyxiation. Remember that, except for oxygen and for air with at least 19.5 percent oxygen, all gas is an asphyxiant. Vent gas only into safe and properly ventilated locations outside the building or fume hood. Exposure to an atmosphere that has 12 percent or less oxygen will bring about unconsciousness without warning and so quickly that the individuals cannot help or protect themselves.

21. Cryogenic Gases
    a. When transferring cryogenic gases inside or have equipment using cryogenic gases that vents anything more than a few cubic centimeters of gas per minute inside (i.e., not to a hood), adequate 24-hour ventilation and continuous oxygen meter(s)/monitor(s) with a "low oxygen" alarm should be installed.
22. Remember, all compressed gases are hazardous; understand those hazards completely and design the system accordingly. The major compressed gas vendors have technical expertise available to support users. Never become complacent when using a compressed gas. Always respect the hazards and treat them accordingly.

B. **Containers**
1. Compressed gas cylinders, containers or tanks containing residual product shall be treated as full except when being examined, serviced or refilled by a gas manufacturer or distributor.
2. Defective cylinders, containers, and tanks shall be returned to the supplier.

C. **Labels and Markings**
1. Individual compressed containers, cylinders and tanks shall be marked or labeled in accordance with USDOT requirements or those of the applicable regulatory agency.
2. The labels applied by the gas manufacturer to identify the liquefied or nonliquefied compressed gas cylinder contents shall not be altered or removed by the user.
3. Markings shall be visible from any direction of approach.

D. **Piping Systems**
1. Piping systems shall be marked in accordance with ASME A13.1, *Scheme for the Identification of Piping Systems*, or other applicable approved standards as follows:
    a. Marking shall include the name of the gas and direction-of-flow arrow.
    b. Piping that is used to convey more than one gas at various times shall be marked to provide clear identification and warning of the hazard.
    c. Marking for piping systems shall be provided at the following locations:
        i. At each critical control valve
        ii. At wall, floor or ceiling penetrations
        iii. At each change of direction
        iv. At a minimum of every 20 feet or fraction thereof throughout the piping run

E. **Security and Physical Protection**
1. Compressed gas containers, cylinders and tanks shall be secured against accidental dislodgement and against access by unauthorized personnel.
2. Compressed gas containers, cylinders and tanks that could be exposed to physical damage shall be protected.
3. Guard posts or other means shall be provided to protect compressed gas containers, cylinders or tanks indoors and/or outdoors from vehicular damage.
4. Compressed gas containers, cylinders or tanks in use or storage shall be secured to prevent them from falling or being knocked over by corralling them and securing them to a fixed object by use of a restraint.
5. Compressed gas container, cylinder and tank valves shall be protected from physical damage by means of protective caps, collars or similar devices.
6. Where compressed gas containers, cylinders and tanks are designed to accept valve-protective caps, the user shall keep such caps on the compressed gas container, cylinder or tank at all times, except when being processed or connected for use.
7. Gastight valve outlet caps or plugs shall be provided and in place for all full, partially full containers, cylinders and tanks containing toxic, highly toxic, pyrophoric, unstable reactive class 3 or unstable reactive class 4 gases that are in storage.

F. **Separate from Hazardous Conditions**
1. Compressed gas containers, cylinders and tanks in storage or use shall be separated from materials and conditions that present exposure hazards to or from each other.
2. Compressed gas containers, cylinders and tanks in storage or use shall be separated in accordance with **Table Two**. The definitions for Reactive Class 2,3 and 4 can be found under Unstable Reactive Gas in the Definitions section.

Table Two: Separation of Gas Cylinders, Containers, and Tanks by Hazard Class

Gas Category	Reactive Class 2, 3 or 4	Corrosive	Oxidizing	Flammable	Pyrophoric	Toxic or Highly Toxic	Other Gas
Toxic or Highly Toxic	20 feet	20 feet	20 feet	20 feet	20 feet	NA	Not Required
Pyrophoric	20 feet	20 feet	20 feet	20 feet	NA	20 feet	Not Required
Flammable	20 feet	20 feet	20 feet	NA	20 feet	20 feet	Not Required
Oxidizing	20 feet	20 feet	NA	20 feet	20 feet	20 feet	Not Required
Corrosive	20 feet	NA	20 feet	20 feet	20 feet	20 feet	Not Required
Reactive Class 2, 3 or 4	NA	20 feet	20 feet	20 feet	20 feet	20 feet	Not Required
Other Gas	Not Required	Not Required	Not Required	Not Required	Not Required	Not Required	NA

3. The 20 foot distance shall be permitted to be reduced without limit when separated by a barrier of noncombustible materials at least 5 feet high that has a fire resistance rating of at least 30 minutes.
4. The 20 foot distance shall be permitted to be reduced to 5 feet where one of the gases is enclosed in a gas cabinet or without limit where both gases are enclosed in gas cabinets.
5. Compressed gas containers, cylinders and tanks shall be kept a minimum of 10 feet from combustible waste, vegetation and similar materials.
6. Compressed gas containers, cylinders and tanks shall not be placed near elevators, unprotected platform ledges or other areas where compressed gas containers, cylinders or tanks could fall for distances exceeding one-half the height of the container, cylinder or tank.
7. Compressed gas containers, cylinders and tanks, whether full or partially full, shall not be exposed to temperatures exceeding 125ºF or sub-ambient temperatures, unless designed for use under these conditions.
8. Compressed gas containers, cylinders and tanks shall not be exposed to corrosive chemicals or fumes that could damage containers, cylinders or tanks or valve-protective caps.
9. Compressed gas containers, cylinders and tanks shall not be placed where they could become part of an electrical circuit.

G. **Leaks, Damage, and Corrosion**

1. Leaking, damaged or corroded gas containers, cylinders and tanks shall be removed from service.
2. To prevent bottom corrosion, containers, cylinders and tanks shall be protected from direct contact with soil or surfaces where water might accumulate.

H. **Storage**

1. Cylinders, containers and tanks containing liquefied flammable gases and flammable gases in solution shall be positioned in the upright position.
2. Containers with a capacity of 1.3 gallons or less shall be permitted to be stored in a horizontal position.
3. Cylinders, except nominal 0.5 kg (1lb) propane cylinders made for consumer use that are not necessary for current laboratory requirements shall be stored outside the laboratory unit in accordance with NFPA 55.
4. Cylinders not “in use” shall not be stored in the laboratory unit.
5. Inflatable equipment, devices or balloons shall only be pressurized or filled with compressed air or inert gases.

6. Compressed Gases used for welding must meet the following storage criteria or the "24-hour" rule applies:
    a. No more than a single acetylene cylinder and a single oxygen cylinder are stored on a cylinder cart. The cylinder cart must be specifically designed to hold/carry acetylene and oxygen cylinders in the upright position. The cylinders must be securely held to the cart (such as by straps, chains, or other securing device).
    b. The cart is on a firm, level surface.
    c. The cart is not in an area where there is a reasonably foreseeable risk of being struck by vehicles, equipment, or materials (such as in a pathway for vehicles on a construction site).
    d. Both cylinders either have valves closed with protection caps on or are connected to a properly functioning regulator.

I. **Handling**

1. Containers, cylinders and tanks shall be moved using an approved method.
2. Where containers, cylinders or tanks are moved by a hand cart, hand truck or other mobile device, such items shall be designed for the secure movement of containers, cylinders or tanks.
3. Ropes, chains and slings shall not be used to suspend compressed gas containers, cylinders or tanks, unless provisions have been made at the time of manufacture on the container, cylinder or tank for appropriate lifting attachments, such as lugs.

J. Resources

1. For additional resources see Appendix A.

5.5 Specific Types of Gases

A. **Corrosive Gases**

1. The outdoor storage of corrosive gases shall not be within 20 feet of buildings, lot lines, streets, alleys, public ways or means of egress.
2. A 2 hour fire barrier wall without openings or penetrations and extending not less than 30 inches above and to the sides of the storage or use area, shall be permitted in lieu of the 20 foot distance.
3. The fire barrier wall shall be either an independent structure or the exterior wall of the building adjacent to the storage or use area.
4. The 2 hour fire barrier shall be located at least 5 feet from any exposure.
5. The 2 hour fire barrier shall not have more than two sides at approximately 90 degree directions or not more than 3 sides with connecting angles of approximately 135 degrees.
6. The indoor use of corrosive gases shall be provided with a gas cabinet, exhausted enclosure or gas room.
7. The exhaust from gas cabinets, exhausted enclosures and gas rooms shall be directed to treatment systems designed to process the accidental release of gas.
8. Gas treatment is not required if there is a gas detection system with sensing intervals not exceeding 5 minutes and fail safe automatic closing valves immediately adjacent to and downstream of the active container, cylinder or tank.
9. The fail-safe valve shall close when the gas is detected at the permissible exposure limit, short term exposure limit or ceiling limit.

B. **Flammable Gases**

1. The outdoor storage or use of flammable compressed gas shall be in accordance with **Table Three**.

Table Three: Distances to Exposures for Flammable Gases

Maximum Amount per Storage Area	Minimum Distances to Buildings, Streets or Public Ways	Minimum Distances Between Storage Areas
<4,225 ft^3	5 Feet	5 Feet
4,226 – 21,125 ft^3	10 Feet	10 Feet
21,126 – 50,700 ft^3	15 Feet	10 Feet
50,701-84,500 ft^3	20 Feet	10 Feet
>84,501 ft^3	25 Feet	20 Feet

Note: The minimum required distances does not apply where fire barriers without openings or penetrations having a minimum fire-resistive rating of 2 hours interrupt the line of sight between the storage and the exposure. The configuration of the fire barriers shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

2. The minimum required distances shall be reduced to 5 feet where protective structures having a minimum fire resistance rating of 2 hours interrupt the line of site between the container and the exposure. The protective structure shall be at least 5 feet from the storage or use area perimeter.
3. The configuration of the protective structure shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.
4. The storage and use of flammable compressed gases shall not be located within 50 feet of air intakes.
5. Static producing equipment shall be grounded.
6. Signs shall be posted in area containing flammable gases communicating that smoking or the use of open flame or both is prohibited within 25 feet of the use or storage perimeter.

C. **Oxidizing Gases**

1. The outdoor storage or use of oxidizing compressed gases shall be in accordance with **Table Four.**

Table Four: Distances to Exposures for Oxidizing Gases

Quantity of Gas Stored	Minimum Distances to Buildings, Streets or Public Ways	Minimum Distances Between Storage Areas
0-50,000 ft^3	5 Feet	5 Feet
50,001 – 100,000 ft^3	10 Feet	10 Feet
>100,000 ft^3	15 Feet	15 Feet

2. The distances in **Table Four** shall not apply where protective structures having a minimum fire resistance of 2 hours interrupt the line of sight between the container and the exposure.
3. The protective structure shall be at least 5 feet from the storage or use area perimeter.
4. The configuration of the protective structure shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

D. **Pyrophoric Gases**

1. The outdoor storage or use of pyrophoric compressed gases shall be in accordance with **Table Five.**

Table Five: Distances to Exposures for Pyrophoric Gases

			Minimum Distances to Buildings on the Same Property			
Maximum Amount per Area	**Minimum Distance Between Storage Areas**	**Minimum Distance to Property Lines**	**Minimum Distance to Public Ways**	**Nonrated or Openings Within 25 Feet**	**2 Hour and No Openings Within 25 Feet**	**4 Hour and No Openings Within 25 Feet**
250 ft^3	5 Feet	25 Feet	5 Feet	5 Feet	0 Feet	0 Feet
> 250 - 2,500 ft^3	10 Feet	50 Feet	10 Feet	10 Feet	5 Feet	0 Feet
> 2,500 - 7,500 ft^3	20 Feet	100 Feet	20 Feet	20 Feet	10 Feet	0 Feet

2. The distances in **Table Five** shall not apply where protective structures having a minimum fire resistance of 2 hours interrupt the line of sight between the container and the exposure.
3. The protective structure shall be at least 5 feet from the storage or use area perimeter.
4. The configuration of the protective structure shall be designed to allow natural ventilation to prevent the accumulation of hazardous gas concentrations.

E. **Toxic and Highly Toxic Gases**

1. The indoor storage or use of highly toxic or toxic gases shall be provided with a gas cabinet, exhausted enclosure or gas room. Gas cabinets, exhausted enclosures and gas rooms containing toxic or highly

toxic gases shall be provided with exhaust ventilation. All ventilation exhaust shall be directed to a treatment system designed to process accidental releases of gas.

2. The outdoor storage or use of toxic or highly toxic compressed gases shall not be within 75 feet of lot lines, streets, alleys, public ways, means of egress or buildings.
3. Storage and use of toxic and highly toxic compressed gases shall not be located within 75 feet of air intakes.
4. While in storage treatment systems are not required for toxic and highly toxic gases if the valve outlets are equipped with plugs or caps that are rated for the container service pressure and the handwheels are secured to prevent movement.
5. While in use treatment systems are not required if toxic gases and only toxic gases if a gas sensing system is in place with a sensing interval that does not exceed 5 minutes and there is a an automatic closing fail safe valve located immediately adjacent to and downstream of the active container, cylinder or tank. The gas detection system shall monitor the exhaust system at the point of discharge from the gas cabinet, exhausted enclosure or gas room.
6. The fail-safe valve shall close when gas is detected at the permissible exposure limit, short term exposure limit or ceiling limit by the detection system.

F. **Cryogenic Fluids**

1. Containers employed for the storage or use of cryogenic fluids shall be designed, fabricated, tested, marked and maintained in accordance with the United States Department of Transportation regulations: *Transportation of Dangerous Goods Regulations*; the American Society of Mechanical Engineers, *Boiler and Pressure Vessel Code, Rules for the Construction of Unfired Pressure Vessels*.
2. Portable cryogenic containers shall be marked in accordance with CGA C-7, *Guide to the Preparation of Precautionary Labeling and Marking of Compressed Gas Containers*.
3. All DOT-4L Liquid cylinders shall have product identification from all directions with a minimum of 2 inch high letters.
4. Visible hazard identification signs shall be provided in accordance with NFPA 704, *Standard System for the Identification of the Hazards of Materials for Emergency Response*, at entrances to buildings or areas in which cryogenics fluids are stored, handled or used.
5. Portable containers subject to shifting or upset shall be secured. Nesting shall be permitted as a means of securing portable containers.
6. Areas where cryogenic fluids are stored or dispensed, shall be provided with mechanical ventilation or natural ventilation. If natural ventilation is provided, it must be demonstrated that it is acceptable for the cryogenic fluid being stored or used.
7. Where mechanical ventilation is provided, the system shall be operational during the time the building or space is occupied.
8. Mechanical ventilation shall be at a rate not less than 1 $ft^3/min/ft^2$ of floor area over the area of storage or use. The system shall operate continuously unless an alternate design is approved by the Authority Having Jurisdiction.
9. Where mechanical ventilation is provided, a manual shutoff switch shall be provided outside of the room in a position adjacent to the principal access door to the room in an approved location. The switch shall be the break-glass or equivalent type and shall be labeled as follows: **Warning: Ventilation System Emergency Shutoff**.

G. **Hydrogen Gas**

1. No more than 400 ft^3 of hydrogen per control area can be stored or used at a time indoors.
2. Valves, gauges, regulators and other accessories used for hydrogen shall be specified for hydrogen service by the manufacturer or the hydrogen supplier.
3. Cabinets or enclosures containing hydrogen control or operating equipment shall be ventilated to minimize the accumulation of hydrogen.
4. Hazard identification shall be placed at all entrances to locations where hydrogen is stored, used or handled, in accordance with NFPA 704, *Standard for the Identification of the Hazards for Materials for Emergency Response*.
5. Further, the area shall be permanently posted as follows: **Warning: Hydrogen Flammable Gas No Smoking No Open Flames**

6. All containers, cylinders and tanks of hydrogen stored or used within 50 feet of all classes of flammable and combustible liquids shall be located at a higher elevation than such liquids as to prevent the accidental accumulation of these liquids under the system.
7. Hydrogen containers, cylinders and tanks shall be separated from other incompatible materials.
8. Hydrogen containers, cylinders and tanks shall be kept a minimum distance of 25 feet from open flames, ordinary electrical equipment, or other sources of ignition.
9. Hydrogen containers, cylinders and tanks shall be kept a minimum of 50 feet from air intakes, air conditioning equipment and air compressors.
10. When placing single container, cylinder or tank of hydrogen in a laboratory, room or other indoor area for use or storage the maximum distance possible between other flammable and oxidizing compressed gases shall be used.

6. GENERAL PROCEDURES FOR WORKING WITH PARTICULARLY HAZARDOUS SUBSTANCES, ALLERGENS, AND EMBRYOTOXINS

6.1 Particularly Hazardous Substances (PHSs)

The OSHA Laboratory Standard requires as part of the Chemical Hygiene Plan that provisions for additional employee protection be included for work involving particularly hazardous substances. These substances include "select carcinogens", reproductive toxins, and substances which have a high degree of acute toxicity. Each of these categories will be discussed in detail in later sections.

The OSHA Laboratory Standard states for work involving particularly hazardous substances, specific consideration be given to the following provisions where appropriate:

1. Establishment of a designated area.
2. Use of containment devices such as fume hoods or glove boxes.
3. Procedures for safe removal of contaminated waste.
4. Decontamination procedures.

EHS can assist researchers by providing information on working with particularly hazardous substances. General guidelines and recommendations for the safe handling, use, and control of hazardous chemicals and particularly hazardous substances can be found in SDSs and other references such as Prudent Practices in the Laboratory (available through The National Academies Press) and Safety in Academic Chemical Laboratories, a publication of the American Chemical Society Joint Board-Council Committee on Chemical Safety.

A. **Establishment of a Designated Area**
   1. For work involving particularly hazardous substances, laboratories should establish a designated area where particularly hazardous substances can only be used. In some cases, a designated area could be an entire room out of a suite of rooms, or could mean one particular fume hood within a laboratory. The idea is to designate one area that everyone in the laboratory is aware of where the particularly hazardous substances can only be used.
   2. In certain cases of establishing designated areas, Principal Investigators and laboratory supervisors may want to restrict use of a particularly hazardous substance to a fume hood, glove box or other containment device. This information should be included as part of the laboratory's SOPs and covered during in-lab training.
   3. Establishing a designated area not only provides better employee protection, but can help minimize the area where potential contamination of particularly hazardous substances could occur. If a designated area is established, a sign should be hung up (on a fume hood for example) indicating the area is designated for use with particularly hazardous substances. Most designated areas will have special PPE requirements and/or special waste and spill cleanup procedures as well. These and other special precautions should be included within the lab's SOPs.

B. **Safe Removal of Contaminated Materials and Waste**
   1. Some particularly hazardous substances may require special procedures for safe disposal of both waste and/or contaminated materials. When in doubt, contact EHS to determine proper disposal procedures. Once these disposal procedures have been identified, they should be included as part of the laboratory's SOPs and everyone working in the lab should be trained on those procedures.

C. **Decontamination Procedures**

1. Some particularly hazardous substances may require special decontamination or deactivation procedures (such as Diaminobenzidine waste or Ethidium bromide) for safe handling. Review SDSs and other reference materials when working with particularly hazardous substances to identify if special decontamination procedures are required. If they are required, then this information should be included in the laboratory's SOPs and appropriate training needs to be provided to laboratory personnel who work with these chemicals.

D. **Guidelines for Working with Particularly Hazardous Substances**

Laboratory staff should always practice good housekeeping, use engineering controls, wear proper PPE, develop and follow SOPs, and receive appropriate training when working with any chemicals. The following special guidelines should be adhered to when working with particularly hazardous substances:

1. Substitute less hazardous chemicals if possible to avoid working with particularly hazardous substances and keep exposures to a minimum.
2. Always obtain prior approval from the Principal Investigator before ordering any particularly hazardous substances.
3. Plan the experiment out in advance, including layout of apparatus and chemical and waste containers that are necessary. A practice or test run of the process without the use of hazardous chemicals can help identify hazardous steps and be used when training others.
4. Before working with any particularly hazardous substance, review chemical resources for any special decontamination/deactivation procedures and have on hand the appropriate spill cleanup and absorbent materials.
5. Ensure that laboratory workers have and wear the appropriate PPE, particularly gloves (check glove selection charts or call EHS).
6. Always use the minimum quantities of chemicals necessary for the experiment. If possible, try adding buffer directly to the original container and making dilutions directly.
7. If possible, purchase pre-made solutions to avoid handling powders. For non-water reactive powders, it is advisable to surround the weighing area with wetted paper towels to facilitate cleanup. If powders must be used, then it is best to weigh them in a fume hood. If it is necessary to weigh outside of a fume hood, then contact the EHS Industrial Hygiene group to evaluate potential exposures and/or need for respiratory protection.
8. As a measure of coworker protection when weighing out dusty materials or powders, consider waiting until other coworkers have left the room to prevent possible exposure and thoroughly clean up and decontaminate working surfaces.
9. Whenever possible, use secondary containment, such as trays, in which to conduct an experiment and for storage of particularly hazardous substances.
10. Particularly hazardous substances should be stored by themselves in clearly marked trays or containers indicating what the hazard is i.e. "Carcinogens," Reproductive Toxins", etc.
11. Always practice good personal hygiene, especially frequent hand washing, even if wearing gloves.
12. If it is necessary to use a vacuum for cleaning particularly hazardous substances, only High Efficiency Particulate Air (HEPA) filters are recommended for best capture and protection. Be aware that after cleaning up chemical powders, the vacuum bag and its contents may have to be disposed of as hazardous waste.
13. Ensure information related to the experiment is included within any SOPs.

E. **Prior Approval**

1. See Section 2.2 for information involving Prior Approval and the use of Particularly Hazardous Substances.

F. **Select Carcinogens**

A carcinogen is any substance or agent that is capable of causing cancer – the abnormal or uncontrolled growth of new cells in any part of the body in humans or animals. Most carcinogens are chronic toxins with long latency periods that can cause damage after repeated or long duration exposures and often do not have immediate apparent harmful effects.

The OSHA Lab Standard defines a "select carcinogen" as any substance which meets one of the following criteria:

1. It is regulated by OSHA as a carcinogen; or

2. It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP); or
3. It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC) (latest editions); or
4. It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals in accordance with any of the following criteria:
    a. After inhalation exposure of 6-7 hours per day, 5 days per week, for a significant portion of a lifetime to dosages of less than 10 mg/m(3);
    b. After repeated skin application of less than 300 (mg/kg of body weight) per week; or
    c. After oral dosages of less than 50 mg/kg of body weight per day.
5. With regard to mixtures, OSHA requires that a mixture "shall be assumed to present a carcinogenic hazard if it contains a component in concentrations of **0.1% or greater**, which is considered to be carcinogenic." When working with carcinogens, laboratory staff should adhere to Guidelines for Working with Particularly Hazardous Substances.
6. Note that the potential for carcinogens to result in cancer can also be dependent on other "lifestyle" factors such as:
    a. Cigarette smoking
    b. Alcohol consumption
    c. Consumption of high fat diet
    d. Geographic location – industrial areas and UV light exposure
    e. Therapeutic drugs
    f. Inherited conditions

More information on carcinogens, including numerous useful web links such as a listing of OSHA regulated carcinogens, can be found on the OSHA Safety and Health Topics for Carcinogens webpage. The State of California has developed an extensive list of "Carcinogens Known to the State of California through Prop 65". Please note, this list is being provided as supplemental information to the OSHA, NTP and IARC chemical lists and may not be legally mandated by other states.

G. **Reproductive Toxins**
1. The OSHA Lab Standard defines a reproductive toxin as a chemical "which affects the reproductive capabilities including chromosomal damage (mutations) and effects on fetuses (teratogenesis)".
2. A number of reproductive toxins are chronic toxins that cause damage after repeated or long duration exposures and can have long latency periods. Women of childbearing potential should be especially careful when handling reproductive toxins. Pregnant women and women intending to become pregnant, or men seeking to have children, should seek the advice of their physician or university health services before working with known or suspected reproductive toxins.
3. It is important to be aware of the threats to reproductive health and prevent potential reproductive hazard exposures for male and female employees and students who work with known and suspected reproductive toxins including chemical, biological, radiological, and physical agents. EHS is available to respond to concerns or questions on reproductive hazards, conduct workplace hazard assessments, and provide recommendations to address or eliminate specific reproductive risks. This free service can be requested by completing the confidential Reproductive Hazard Assessment Form. As with any particularly hazardous substance, work involving the use of reproductive toxins should adhere to Section D.
4. More information on reproductive toxins, including numerous useful web links, can be found on the OSHA Safety and Health Topics for Reproductive Hazards webpage. The State of California has developed an extensive list of "Reproductive Toxins Known to the State of California through Prop 65". Please note, this list is being provided as supplemental information to the OSHA, NTP and IARC chemical lists and may not be legally mandated by other states.

H. **Acute Toxins**
1. OSHA defines a chemical as being highly toxic if it falls within any of the following categories:
    a. A chemical that has a median lethal dose (LD50) of 50 milligrams or less per kilogram of body weight when administered orally to albino rats weighing between 200 and 300 grams each.

b. A chemical that has a median lethal dose (LD50) of 200 milligrams or less per kilogram 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.
c. A chemical that has a median lethal concentration (LC50) in air of 200 parts per million by volume or less of gas or vapor, or 2 milligrams per liter or less 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.

2. Information on determining whether or not a chemical meets one of these definitions can be found in SDSs and other chemical references.
3. As with any particularly hazardous substance, work involving the use of acute toxins should adhere to Section D. In addition to following the Guidelines for Working with Particularly Hazardous Substances, additional guidelines for working with acute toxins include:
   a. Consider storing highly toxic materials in a locked storage cabinet.
   b. Be aware of any special antidotes that may be required in case of accidental exposure; for example, the special application of calcium gluconate gel is recommended for hydrofluoric acid burns and polyethylene glycol 300 or 400 is for dermal phenol exposures.
   c. Give particular attention to the selection of gloves and other personal protective equipment.
   d. Do not work with highly toxic chemicals outside of a fume hood, glove box or ventilated enclosure
4. More information on acute toxins, including numerous useful web links, can be found on the OSHA Safety and Health Topics for Hazardous and Toxic Substances webpage.

6.2 Allergens and Embryotoxins

It is important that the SDS's be reviewed for proper PPE and any other safety concerns related to these specific chemicals. Contact the CHO or EHS with questions.

A. **Allergens** (examples: diazomethane, isocyanates, bichromates): Wear suitable gloves to prevent hand contact with allergens or substances of unknown allergenic activity.
B. **Embryotoxins** (examples: organomercurials, lead compounds, formamide): Women of childbearing age, should handle these substances only in a fume hood whose satisfactory performance has been confirmed, using appropriate protective apparel (especially gloves) to prevent skin contact.
C. Review each use of these materials with the research supervisor and review continuing uses annually or whenever a procedural change is made. Store these substances, properly labeled, in an adequately ventilated area in an unbreakable secondary container. Notify supervisors of all incidents of exposure or spills; consult a qualified physician when appropriate.

6.3 Chemicals of Moderate Chronic or High Acute Toxicity

Supplemental rules to be followed in addition to those mentioned above, it is also imperative that the SDS is read. Please follow instructions and take all safety precautions seriously. See Appendix A for a link to Acutely Hazardous P-Listed Waste and to the EHS Waste Management SOP.

A. **Aim:** To minimize exposure to these toxic substances by any route using all reasonable precautions.
B. **Applicability:** These precautions are appropriate for substances with moderate chronic or high acute toxicity used in significant quantities.
C. **Location:** use and store these substances only in areas of restricted access with special warning signs. Always use a hood (previously evaluated to confirm adequate performance with a face velocity of at least 60 linear feet per minute) or other containment device for procedures which may result in the generation of aerosols or vapors containing the substance; trap released vapors to prevent their discharge with the hood exhaust.
D. **Personal protection:** Always avoid skin contact by use of gloves and long sleeves (and other protective apparel as appropriate). Always wash hands and arms immediately after working with these materials.
E. **Records:** Maintain records of the amounts of these materials on hand, amounts used, and the names of the workers involved.
F. **Prevention of spills and accidents:** Be prepared for accidents and spills. Assure that at least 2 people are present at all times if a compound in use is highly toxic or of unknown toxicity.
G. **Storage:** Store breakable containers of these substances in chemically resistant trays; also work and mount apparatus above such tray or cover work and storage surfaces with removable, absorbent, plastic backed

paper. If a major spill occurs outside the hood, evacuate the area; assure that cleanup personnel wear suitable protective apparel and equipment.

H. **Waste:** To dispose of waste please follow the procedures in Section 2.9.

6.4 Chemicals of High Chronic Toxicity

Supplemental rules to be followed in addition to those mentioned above, it is also imperative that the SDS is read. Please follow instructions and take all safety precautions seriously.

A. **Access:** Conduct all transfers and work with these substances in a "controlled area": a restricted access hood, glove box, or portion of a lab, designated for use of highly toxic substances, for which all people with access are aware of the substance being used and necessary precautions.

B. **Approvals***:* Prepare a plan for use and disposal of these materials and obtain the approval of the laboratory supervisor.

C. **Non-contamination/Decontamination:** protect vacuum pumps against contamination by scrubbers or HEPA filters and vent them into the hood. Decontaminate vacuum pumps or other contaminated equipment, including glassware, in the hood before removing them from the controlled area. Decontaminate the controlled area before normal work is resumed there.

D. **Exiting:** On leaving a controlled area, remove any protective apparel (placing it in an appropriate, labeled container) and thoroughly wash hands, forearms, face, and neck.

E. **Housekeeping:** Use a wet mop or a vacuum cleaner equipped with a HEPA filter instead of dry sweeping if the toxic substance was a dry powder.

F. **Medical surveillance:** If using toxicologically significant quantities of such a substance on a regular basis (*i.e.*, 3 times per week), consult a qualified physician concerning desirability of regular medical surveillance.

G. **Records:** Keep accurate records of the amounts of these substances stored and used, the dates of use, and names of users.

H. **Signs and labels:** Assure that the controlled area is conspicuously marked with warning and restricted access signs and that all containers of these substances are appropriately labeled with identity and warning labels.

I. **Spills:** Assure that contingency plans, equipment, and materials to minimize exposures of people and property in case of accident are available.

J. **Storage:** Store containers of these chemicals only in a ventilated, limited access area in appropriately labeled, unbreakable, chemically resistant, secondary containers.

K. **Glove boxes***:* For a negative pressure glove box, ventilation rate must be at least 2 volume changes/hour and pressure at least 0.5 inch of water. For a positive pressure glove box, thoroughly check for leaks before each use. In either case, trap exit gases of filter them through a HEPA filter and then release them into the hood.

L. **Waste:** Use chemical decontamination whenever possible; ensure that containers of contaminated waste (including washings from contaminated flasks) are transferred from the controlled area in a secondary container under the supervision of authorized personnel.

6.5 Animal Work with Chemicals of High Chronic Toxicity

Supplemental rules to be followed in addition to those mentioned above, it is also imperative that the SDS is read. Please follow instructions and take all safety precautions seriously.

A. **Access:** For large scale studies, special facilities with restricted access are preferable.

B. **Administration of the toxic substance:** When possible, administer the substance by injection or gavage instead of in the diet. If administration is in the diet, use a caging system under negative pressure or under laminar air flow directed toward HEPA filters.

C. **Aerosol suppression:** Devise procedures which minimize formation and dispersal of contaminated aerosols, including those form food, urine, and feces (e.g., use HEPA filtered vacuum equipment for cleaning, moisten contaminated bedding before removal from the cage, mix diets in closed containers in a hood).

D. **Personal protection:** When working in the animal room, wear plastic or rubber gloves, fully buttoned laboratory coat or jumpsuit and, if needed because of incomplete suppression of aerosols, other apparel and equipment (shoe and head coverings, respirator).

E. **Waste disposal:** Dispose of contaminated animal tissues and excreta by incineration if the available incinerator can convert the contaminant to non-toxic products; otherwise package the waste appropriately for burial in an EPA-approved site.

Appendix A

General References, Glove Guide Resources, and Compressed Gas References

General References and Glove Guide Resources

OSHA Law and Regulations: https://www.osha.gov/law-regs.html
EPA Laws and Regulations: https://www.epa.gov/laws-regulations
EHS Link to Acutely Hazardous P-List Waste: http://ehs.wvu.edu/environmental/waste-management/hazardous-waste
EHS Waste Management SOP: http://ehs.wvu.edu/files/d/ce70c255-ded8-4545-a6e8-9ee9e2d42bea/waste-management-sop.pdf
Particularly Hazardous Substances List: http://web.ornl.gov/sci/psd/mst/rsg/pdf/OSHA_Haz_List_.pdf

Glove Supplier Links

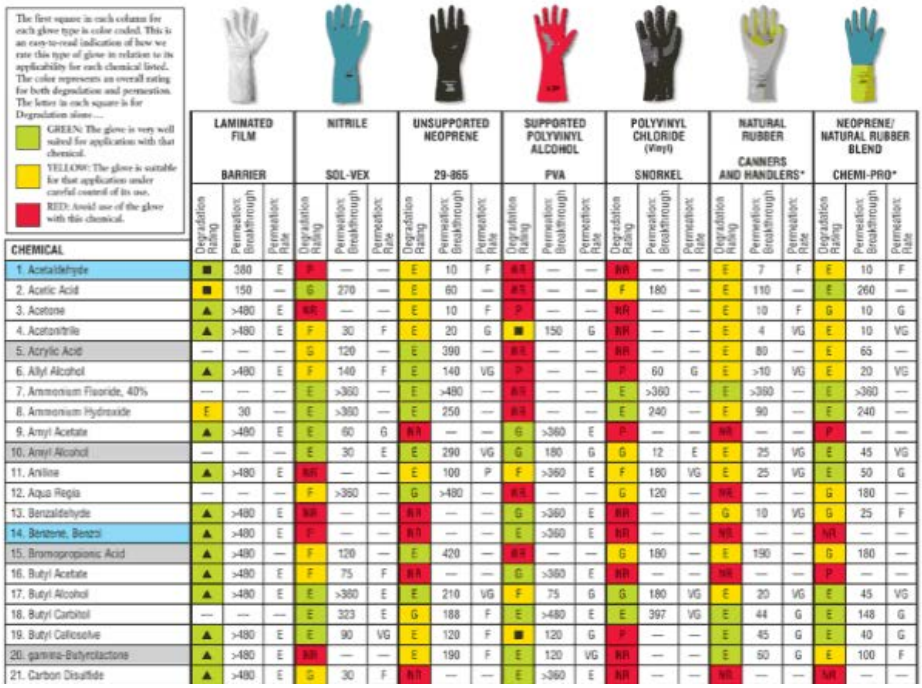
1. Ansell Gloves: http://www.ansell.com/en-US/Products/Gloves/Chemical.aspx
2. Kimberly Clark Technical Glove Data: http://www.kcproductselector.com/gloves.aspx
3. Dupont Industrial Gloves: http://www.dupont.com/products-and-services/fabrics-fibers-nonwovens/fibers/brands/kevlar/products/gloves-kevlar.html
4. North by Honeywell Hand Protection: http://www.honeywellsafety.com/usa/handprotection/

Glove Reference Guides

Chemical Protection Selection Guide: http://www.ansellpro.com/specware/index.asp
MCR Glove Permeation Guide: http://www.mcrsafety.com/resources/tools/glove-permeation/disclaimer
Marigold Glove Selection by Chemical: http://www.marigoldindustrial.com/us/search_chemical_78,390.aspx

Snapshot of Ansell's Chemical Resistance Glove Guide

(Click the chart to be directed to the downloadable guide.)



CHEMICAL	LAMINATED FILM BARRIER			NITRILE SOL-VEX			UNSUPPORTED NEOPRENE 29-865			SUPPORTED POLYVINYL ALCOHOL PVA			POLYVINYL CHLORIDE (Vinyl) SNORKEL			NATURAL RUBBER CANNERS AND HANDLERS*			NEOPRENE/ NATURAL RUBBER BLEND CHEMI-PRO*		
	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	7	F	E	10	F
2. Acetic Acid	■	150	—	G	270	—	E	60	—	NR	—	—	F	180	—	E	110	—	E	260	—
3. Acetone	▲	>480	E	NR	—	—	E	10	F	P	—	—	NR	—	—	E	10	F	G	10	G
4. Acetonitrile	▲	>480	E	F	30	F	E	20	G	■	150	G	NR	—	—	E	4	VG	E	10	VG
5. Acrylic Acid	—	—	—	G	120	—	E	390	—	NR	—	—	NR	—	—	E	80	—	E	65	—
6. Allyl Alcohol	▲	>480	E	F	140	F	E	140	VG	P	—	—	P	60	G	E	>10	VG	E	20	VG
7. Ammonium Fluoride, 40%	—	—	—	E	>360	—	E	>480	—	NR	—	—	E	>360	—	E	>360	—	E	>360	—
8. Ammonium Hydroxide	E	30	—	E	>360	—	E	250	—	NR	—	—	E	240	—	E	90	—	E	240	—
9. Amyl Acetate	▲	>480	E	E	60	G	NR	—	—	G	>360	E	P	—	—	NR	—	—	P	—	—
10. Amyl Alcohol	—	—	—	E	30	E	E	290	VG	G	180	G	G	12	E	E	25	VG	E	45	VG
11. Aniline	▲	>480	E	NR	—	—	E	100	P	F	>360	E	F	180	VG	E	25	VG	E	50	G
12. Aqua Regia	—	—	—	F	>360	—	G	>480	—	NR	—	—	G	120	—	NR	—	—	G	180	—
13. Benzaldehyde	▲	>480	E	NR	—	—	NR	—	—	G	>360	E	NR	—	—	G	10	VG	G	25	F
14. Benzene, Benzol	▲	>480	E	P	—	—	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—
15. Bromopropionic Acid	▲	>480	—	F	120	—	E	420	—	NR	—	—	G	180	—	E	190	—	G	180	—
16. Butyl Acetate	▲	>480	E	F	75	F	NR	—	—	G	>360	E	NR	—	—	NR	—	—	P	—	—
17. Butyl Alcohol	▲	>480	E	E	>360	E	E	210	VG	F	75	G	G	180	VG	E	20	VG	E	45	VG
18. Butyl Carbitol	—	—	—	E	323	E	G	188	F	E	>480	E	E	397	VG	E	44	G	E	148	G
19. Butyl Cellosolve	▲	>480	E	E	90	VG	E	120	F	■	120	G	P	—	—	E	45	G	E	40	G
20. gamma-Butyrolactone	▲	>480	E	NR	—	—	E	190	F	E	120	VG	NR	—	—	E	60	G	E	100	F
21. Carbon Disulfide	▲	>480	E	G	30	F	NR	—	—	E	>360	E	NR	—	—	NR	—	—	NR	—	—

Compressed Gas Cylinder Safety References

A. National Fire Protection Association (NFPA)

1. NFPA 45
2. NFPA 55

B. OSHA Standards for General Industry 29 CFR 1910

1. 29 CFR 1910.101 Compressed Gases (General Requirements)
2. 29 CFR 1910.102 Acetylene
3. 29 CFR 1910.103 Hydrogen
4. 29 CFR 1910.104 Oxygen
5. 29 CFR 1910.105 Nitrous Oxide
6. 29 CFR 1910.253 Oxygen-fuel Gas Welding and Cutting
7. 29 CFR 1926.350 Gas Welding and Cutting

C. Compressed Gas Association

1. CGA Pamphlet P-1 Safe Handling of Compressed Gases

For additional information concerning the proper storage or use of compressed gases or cryogenic fluids please contact Environmental Health and Safety at 304-293-5792.

Appendix B

Chemical Hygiene Plan Approval Document and Emergency Information Checklist

CHEMICAL HYGIENE PLAN APPROVAL DOCUMENT

Laboratory Information

Room Number _____ Phone Number _____

Department _____ Building _____

Title	Name	Office Number and Location	Office Phone Number	Home or Cell Phone Number
P.I.				
Lab Supervisor or Manager				
CHO				
Dept. Chair				
Lab Personnel				
Lab Personnel				
Lab Personnel				

Initial Date of CHP Preparation: _____

Annual Review Date: _____

Reviewed By: _____ _____
Lab Supervisor CHO

Approved By: _____
Dept. Chair

Note: The CHP must be reviewed, approved, and signed annually and updated as necessary.

EMERGENCY INFORMATION CHECKLIST

Check mark the availability of the following and provide the date of issue or the date of last update and location.

Subject	Availability	Date Issued or Last Checked	Location
Emergency Contact List			
Evacuation Procedure			
Compressed Gas Emergency Procedure			
CHP			
SDS			
First Aid Kit			
Fire Extinguisher			
Personal Protective Equipment			
Spill Clean-up Kit			
Fire Alarm			
Gas Shut Off System			
Chemical Inventory			
Waste Inventory			
Eye Wash Station			
Safety Shower Station			

Appendix C
Overview of Safety Data Sheet (SDS)

Safety Data Sheets (formerly called Material Safety Data Sheets) communicate hazard information about chemical products.

The federal Hazard Communication Standard, revised in 2012, now requires chemical manufacturers, distributors, or importers to provide new SDSs in a uniform format that includes the section numbers, headings, and associated information below.

Section 1 – Identification identifies the chemical on the SDS as well as the recommended uses. It also provides the essential contact information of the supplier.

Section 2 – Hazard(s) identification includes the hazards of the chemical and the appropriate warning information associated with those hazards.

Section 3 – Composition/information on ingredients identifies the ingredient(s) contained in the product indicated on the SDS, including impurities and stabilizing additives. This section includes information on substances, mixtures, and all chemicals where a trade secret is claimed.

Section 4 – First-aid measures describes the initial care that should be given by untrained responders to an individual who has been exposed to the chemical.

Section 5 – Fire-fighting measures lists recommendations for fighting a fire caused by the chemical, including suitable extinguishing techniques, equipment, and chemical hazards from fire.

Section 6 – Accidental release measures provides recommendations on the appropriate response to spills, leaks, or releases, including containment and cleanup practices to prevent or minimize exposure to people, properties, or the environment. It may also include recommendations distinguishing between responses for large and small spills where the spill volume has a significant impact on the hazard.

Section 7 – Handling and storage provides guidance on the safe handling practices and conditions for safe storage of chemicals, including incompatibilities.

Section 8 – Exposure controls/personal protection indicates the exposure limits, engineering controls, and personal protective equipment (PPE) measures that can be used to minimize worker exposure.

Section 9 – Physical and chemical properties identifies physical and chemical properties associated with the substance or mixture.

Section 10 – Stability and reactivity describes the reactivity hazards of the chemical and the chemical stability information. This section is broken into 3 parts: reactivity, chemical stability, and other.

Section 11 – Toxicological information identifies toxicological and health effects information or indicates that such data are not available. This includes routes of exposure, related symptoms, acute and chronic effects, and numerical measures of toxicity.

Section 12 – Ecological information provides information to evaluate the environmental impact of the chemical(s) if it were released to the environment.

Section 13 – Disposal considerations provides guidance on proper disposal practices, recycling or reclamation of the chemical(s) or its container, and safe handling practices. To minimize exposure, this section should also refer the reader to Section 8 (Exposure Controls/Personal Protection) of the SDS.

Section 14 – Transport information includes guidance on classification information for shipping and transporting of hazardous chemical(s) by road, air, rail, or sea.

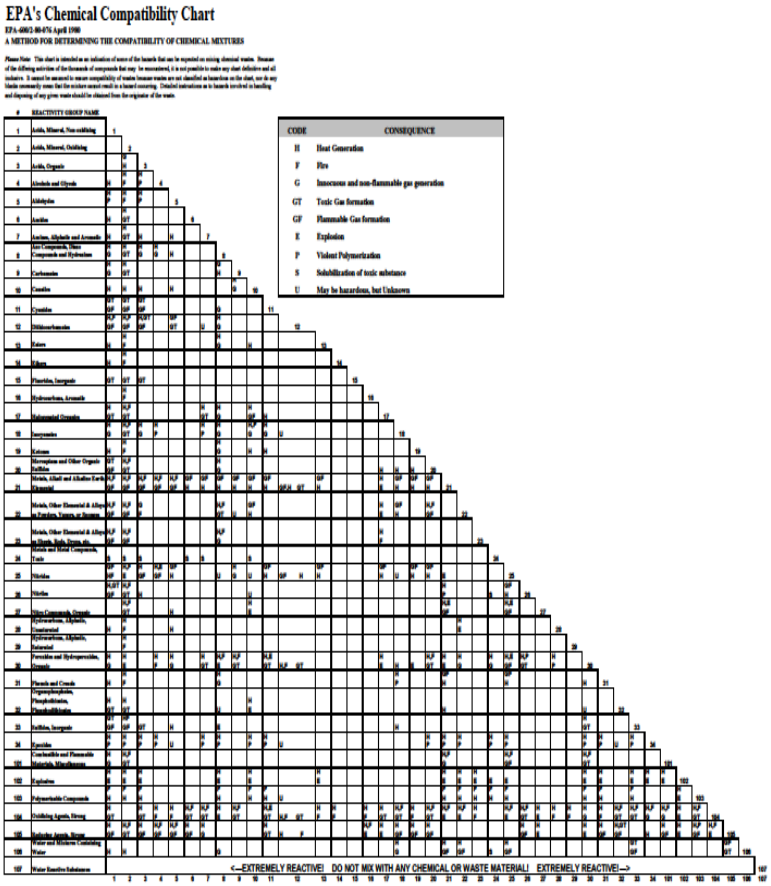
Section 15 – Regulatory information identifies the safety, health, and environmental regulations specific for the product that is not indicated anywhere else on the SDS.

Section 16 – Other information indicates when the SDS was prepared or when the last known revision was made. The SDS may also state where the changes have been made to the previous version. You may wish to contact the supplier for an explanation of the changes. Other useful information also may be included here.

Appendix D
Chemical Compatibility Chart
And
Container Compatiblity Charts

Chemical Compatibility Chart

Click on the image below to be directed to the EHS website. Click on the link to "Chart for Storage of Hazardous Chemicals Based on Compatability"



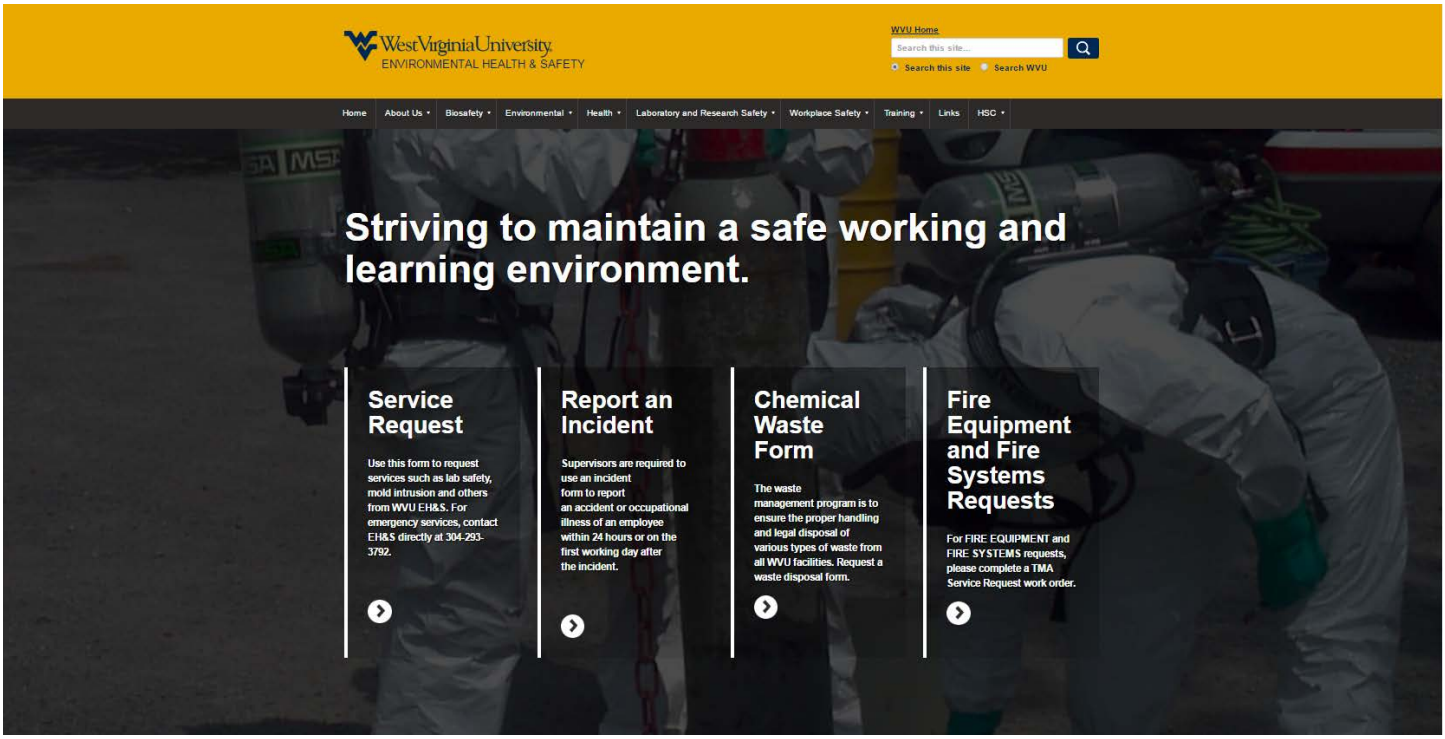
Waste Container/Solvent Compatibility Chart

Solvent	Steel	Stainless Steel	Polyethylene
Acetic Acid	N	Y	Y
Acetone	Y	Y	Y
Aniline	N	Y	Y
Benzene	N	Y	Y
2-Butanone (MEK)	Y	Y	Y
Butylene	Y	Y	N
Chlorofluorocarbons	N	Y	N
Cyclohexane	Y	N	N
Cyclohexanone	N	Y	N
Ethanol	Y	Y	Y
Ethyl Acetate	N	Y	Y
Ethyl Ether	Y	Y	N
Ethylene Glycol	N	Y	Y
Fuel Oil	Y	Y	Y
Gasoline	Y	Y	Y
Heptane	Y	Y	Y
Hexane	Y	Y	Y
Kerosene	Y	Y	Y
Methanol	Y	Y	Y
Methylene Chloride	N	Y	N
Methyl Isobutyl Ketone	Y	Y	Y
Pentane	Y	N	Y
Petroleum Ether	Y	Y	N
Toluene	Y	Y	Y
Trichloroethylene	N	Y	N
Xylene	Y	Y	Y

Appendix E
Chemical Waste Removal

Chemical Waste Removal

1. From the EHS Home page, click on "Chemical Waste Form".



2. Read all of the Form Instructions first.

3. Download and complete the Disposal Request Form.

4. Email your form as an attachment to ehs_chemicals@mail.wvu.edu with "Waste Disposal Request" in the subject line.

Appendix F

Chemical Hygiene Plan: Training Record

Training Record

Use this form to document required and in-lab training participation. Attach this document to the Individual Chemical Hygiene Plan.

Name (print)	Course Title/Training Description	Principal Investigator Signature	Date

Appendix G

Hazard Communication Standard Pictograms

As of June 1, 2015, the Hazard Communication Standard (HCS) will require pictograms on labels to alert users of the chemical hazards to which they may be exposed. Each pictogram consists of a symbol on a white background framed within a red border and represents a distinct hazard(s). The pictogram on the label is determined by the chemical hazard classification. (https://www.osha.gov/Publications/HazComm_QuickCard_Pictogram.html)

Health Hazard

- Carcinogen
- Mutagenicity
- Reproductive Toxicity
- Respiratory Sensitizer
- Target Organ Toxicity
- Aspiration Toxicity

Flame

- Flammables
- Pyrophorics
- Self-Heating
- Emits Flammable Gas
- Self-Reactives
- Organic Peroxides

Exclamation Mark

- Irritant (skin and eye)
- Skin Sensitizer
- Acute Toxicity (harmful)
- Narcotic Effects
- Respiratory Tract Irritant
- Hazardous to Ozone Layer (Non-Mandatory

Gas Cylinder

- Gases Under Pressure

Corrosion

- Skin Corrosion/Burns
- Eye Damage
- Corrosive to Metals

Exploding Bomb

- Explosives
- Self-Reactives
- Organic Peroxides

Flame Over Circle

- Oxidizers

Environment (Non-Mandatory)

- Aquatic Toxicity

Skull and Crossbones

- Acute Toxicity (fatal or toxic)

For downloadable pictograms, click here: https://www.osha.gov/dsg/hazcom/pictograms/