Rowan University
ENVIRONMENTAL HEALTH & SAFETY

Chemical Hygiene Plan Standard Operating Procedures (SOPs):

Covers Chemicals Commonly Used in Laboratories or with Research

August 23, 2020

Acutely Toxic Chemicals

The following Standard operating procedures (SOP) is intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any items listed in this SOP, contact the Principal Investigator of your laboratory, your course director, or the Office of Environmental Health and Safety (856-256-5105 or at ehs@rowan.edu). Specific written procedures for a chemical or hazard are the responsibility of the principal investigator or course director.

If compliance with all the requirements of this SOP is not possible, the principal investigator/course director must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

A list of acutely toxic chemicals is attached at the end of this SOP.

The purchase or possession of Select Agent toxins requires registration with the Centers for Disease Control and Prevention (CDC) or the United States Department of Agriculture (USDA). More information on the possession and use of Select Agents can be obtained by contacting EHS at 856-256-5105 or ehs@rowan.edu. A list of Select Agents is attached at the end of this SOP.

Securing of gas cylinders

Not applicable

Decontamination

- **Personnel:** Wash hands and arms with soap and water immediately after handling acutely toxic chemicals.
- **Area:** Decontamination procedures vary depending on the material being handled. The toxicity of some materials can be neutralized with other reagents. All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling. Waste materials generated should be treated as a hazardous waste.
- **Equipment:** Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

Designated area

The room sign for the laboratory must contain a Designated Areas Within identifier.

All locations within the laboratory where acutely toxic chemicals are handled should be demarcated with designated area caution tape) and/or posted with designated area caution signs. This includes all fume hoods and bench tops where the acutely toxic chemicals are handled.

Where feasible acutely toxic chemicals should be manipulated over plastic-backed disposable paper work surfaces. These disposable work surfaces minimize work area contamination and simplify clean up.

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, should be developed by each laboratory. The procedures should address as a minimum the following:

- **Who to contact:** (Public Safety, Principal investigator/course director of the laboratory including evening phone number and Office of Environmental Health and Safety)
- The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)
- The method used to alert personnel in nearby areas of potential hazards
- Special first aid treatment required by the type of acutely toxic material(s) handled in the laboratory

Fume hood

Manipulation of acutely toxic chemicals should be carried out in a fume hood. If the use of a fume hood proves impractical, refer to the section on special ventilation.

All areas where acutely toxic chemicals are stored or manipulated must be labeled as a designated area.

Glove (dry) box

Certain acutely toxic chemicals must be handled in a glove box rather than a fume hood. The Principal Investigator/course director will determine if this is required.

The Office of Environmental Health and Safety is available to provide guidance if required.

Hazard assessment

Hazard assessment should focus on proper use and handling procedures, the education of employees concerning the health risk posed by acutely toxic materials, and on the demarcation of designated areas.

Personal Protective Equipment

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling acutely toxic chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

The Office of Environmental Health and Safety is available to provide guidance.

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling acutely toxic chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI/ISEA Z87.1-2010) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

Gloves

Gloves should be worn when handling acutely toxic chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. However, the handling of some acutely toxic chemicals will require chemical resistant gloves.

The Principal Investigator/course director is responsible to the select the appropriate chemical resistant glove when direct or prolonged contact with hazardous chemicals is anticipated.

The Office of Environmental Health and Safety is available to provide guidance.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of acutely toxic chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

The Principal Investigator/course director is responsible to the select the appropriate shielding.

The Office of Environmental Health and Safety is available to provide guidance.

Eyewash

Where the eyes or body of any person may be exposed to acutely toxic chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the acutely toxic chemicals are used.

Signs and labels

- **Doorways:** The room sign must contain a Designated Area Within identifier where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used.
- **Containers:** All acutely toxic chemicals must be clearly labeled with the correct chemical name and CAS #. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. Chemical containers must be dated upon receipt as well as when opened.

Special storage

Acutely toxic chemicals must be stored in a designated area.

Special ventilation

Manipulation of acutely toxic chemicals outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to acutely toxic chemicals in the laboratory and are the preferred ventilation control device. Where possible handle acutely toxic chemicals in a fume hood. If the use of a fume hood proves impractical, attempt to work in a glove box or in an isolated area on the laboratory bench top while wearing the appropriate PPE.

If available, consider using a ***ducted*** Biological Safety Cabinet. The ***ducted*** biological safety cabinet is designed to remove the acutely toxic chemicals before the air is discharged into the environment. Acutely toxic chemicals that are volatile must not be used in a biological safety cabinet unless the cabinet is vented to the outdoors. A Biological Safety Cabinet that exhaust into the laboratory is not suitable for this work.

If your research does not permit the handing of acutely toxic chemicals in a fume hood, ***ducted*** biological safety cabinet, or glove box, you must contact the Office of Environmental Health and Safety.

All areas where acutely toxic chemicals are stored or manipulated must be labeled as a designated area.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. It is recommended to purchase a spill kit for your laboratory for this purpose. The appropriate clean up supplies can be determined by consulting the Safety Data Sheet. This should occur prior to the use of any acutely toxic chemical.

In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of acutely toxic chemicals. Vacate the laboratory immediately and call for assistance.

- Public Safety 856-256-911. This is a 24 hour service.
- Office of Environmental Health & Safety, 856-256-5105 or ehs@rowan.edu

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving acutely toxic chemicals must be conducted in a fume hood, glove box or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

Waste disposal

All materials contaminated with acutely toxic chemicals should be disposed of as a hazardous waste. Wherever possible, attempt to design research in a manner that reduces the quantity of waste generated.

Questions regarding waste pick up should be directed to the Office of Environmental Health and Safety. This office can also assist you in minimizing waste generation.

A list of Acutely Toxic Chemicals is provided below, as a guide. The list is not inclusive. Other chemicals and hazardous agents may be periodically added to the list.

A list of Select Agents is provided below. Contact Environmental Health and Safety for prior approval and specific requirements to possess and use any of the listed SELECT AGENTS.

Principal Investigator/Course Director:_____

Laboratory Safety Officer:_____
(Principal Investigator/Course Director is the Laboratory Safety Officer if one is not assigned)

Building:_____ Room(s):_____

Completed By:_____ Date:_____

Where are the designated areas in your laboratory to work with the acutely toxic chemicals (list all acutely toxic chemicals):

Acutely Toxic Chemicals	Designated Area Location (e.g., Chemical Fume Hood)

Acutely Toxic Chemicals

This list is provided as a guide and is not all inclusive. Review Safety Data Sheet

Acrolein	Acrylyl chloride	2-Aminopyridine
Benzyl chloride	Bromine	Chlorine dioxide
Chlorine trifluoride	Chlorpicrin	Cyanogen chloride
Cyanuric fluoride	Decaborane	Dichloro acetylene
Dimethyl disulfide	Dimethylsulfate	Dimethylsulfide
Ethylene chlorohydrin	Ethylene fluorohydrin	Hexamethylene diisocyanate
Hexamethyl phosphoramide	Iodine	Iron pentacarbonyl
Isopropyl formate	Methacryloyl chloride	Methacryloxyethyl isocyanate
Methyl acrylonitrile	Methyl chloroformate	Methylene biphenyl isocyanate
Methyl fluoroacetate	Methyl fluorosulfate	Methyl hydrazine
Methyl Mercury (and other organicforms)	Methyltrichlorosilane	Methyl vinyl ketone
Nickel carbonyl	Nitrogen tetroxide	Nitrogen trioxide
Organo Tin compounds	Osmium tetroxide	Oxygen difluoride
Ozone	Pentaborane	Perchloromethyl mercaptan
Phosphorus oxychloride	Phosphous trichloride	Sarin
Sulfur monochloride	Sulfur pentafluoride	Sulfuryl chloride
Tellurium hexafluoride	Tetramethyl succinonitrile	Tetranitromethane
Thionyl chloride	Toluene-2,4-diisocyanate	Trichloro (chlormethyl) silane

LIST OF SELECT AGENTS

The following biological agents and toxins have been determined to have the potential to pose a severe threat to both human and animal health, to plant health, or to animal and

plant products. An attenuated strain of a select agent or an inactive form of a select toxin may be excluded from the requirements of the Select Agent Regulations. Here is a list of excluded agents and toxins.

7CFR Part 331, 9 CFR Part 121, and 42 CFR Part 73

HHS SELECT AGENTS AND TOXINS

Abrin
Bacillus cereus Biovar *anthracis**
Botulinum neurotoxins*
Botulinum neurotoxin producing species of *Clostridium**

Conotoxins (Short, paralytic alpha conotoxins containing the following amino acid sequence $X_1CCX_2PACGX_3X_4X_5X_6CX_7$)[1]

Coxiella burnetii
Crimean-Congo haemorrhagic fever virus
Diacetoxyscirpenol
Eastern Equine Encephalitis virus[3]
Ebola virus*
*Francisella tularensis**
Lassa fever virus
Lujo virus
Marburg virus*
Monkeypox virus[3]
Reconstructed replication competent forms of the 1918 pandemic influenza virus containing any portion of the coding regions of all eight gene segments (Reconstructed 1918 Influenza virus)

Ricin
Rickettsia prowazekii
SARS-associated coronavirus (SARS-CoV)
Saxitoxin
South American Haemorrhagic Fever viruses:
Chapare
Guanarito
Junin
Machupo
Sabia

Staphylococcal enterotoxins A,B,C,D,E subtypes
T-2 toxin
Tetrodotoxin
Tick-borne encephalitis complex (flavi) viruses:
Far-Eastern subtype
Siberian subtype

Kyasanur Forest disease virus
Omsk hemorrhagic fever virus
Variola major virus (Smallpox virus)*
Variola minor virus (Alastrim)*
*Yersinia pestis**

OVERLAP SELECT AGENTS AND TOXINS

*Bacillus anthracis**
Bacillus anthracis Pasteur strain
Brucella abortus
Brucella melitensis
Brucella suis
*Burkholderia mallei**
*Burkholderia pseudomallei**
Hendra virus
Nipah virus
Rift Valley fever virus
Venezuelan equine encephalitis virus[3]

USDA SELECT AGENTS AND TOXINS

African horse sickness virus
African swine fever virus
Avian influenza virus[3]
Classical swine fever virus
Foot-and-mouth disease virus*
Goat pox virus
Lumpy skin disease virus
Mycoplasma capricolum[3]
Mycoplasma mycoides[3]
Newcastle disease virus[2,3]
Peste des petits ruminants virus
Rinderpest virus*
Sheep pox virus
Swine vesicular disease virus

USDA PLANT PROTECTION AND QUARANTINE (PPQ) SELECT AGENTS AND TOXINS

Peronosclerospora philippinensis (Peronosclerospora sacchari)
Phoma glycinicola (formerly Pyrenochaeta glycines)
Ralstonia solanacearum
Rathayibacter toxicus
Sclerophthora rayssiae
Synchytrium endobioticum
Xanthomonas oryzae

*Denotes Tier 1 Agent

[1] C = Cysteine residues are all present as disulfides, with the 1st and 3rd Cysteine, and the 2nd and 4th Cysteine forming specific disulfide bridges; The consensus sequence includes

known toxins α-MI and α-GI (shown above) as well as α-GIA, Ac1.1a, α-CnIA, α-CnIB; X1 = any amino acid(s) or Des-X; X2 = Asparagine or Histidine; P = Proline; A = Alanine; G = Glycine; X3 = Arginine or Lysine; X4 = Asparagine, Histidine, Lysine, Arginine, Tyrosine, Phenylalanine or Tryptophan; X5 = Tyrosine, Phenylalanine, or Tryptophan; X6 = Serine, Threonine, Glutamate, Aspartate, Glutamine, or Asparagine; X7 = Any amino acid(s) or Des X and; "Des X" = "an amino acid does not have to be present at this position." For example if a peptide sequence were XCCHPA then the related peptide CCHPA would be designated as Des-X.

2 A virulent Newcastle disease virus (avian paramyxovirus serotype 1) has an intracerebral pathogenicity index in day-old chicks (Gallus gallus) of 0.7 or greater or has an amino acid sequence at the fusion (F) protein cleavage site that is consistent with virulent strains of Newcastle disease virus. A failure to detect a cleavage site that is consistent with virulent strains does not confirm the absence of a virulent virus.

3 Select agents that meet any of the following criteria are excluded from the requirements of this part: Any low pathogenic strains of avian influenza virus, South American genotype of eastern equine encephalitis virus , west African clade of Monkeypox viruses, any strain of Newcastle disease virus which does not meet the criteria for virulent Newcastle disease virus, all subspecies Mycoplasma capricolum except subspecies capripneumoniae (contagious caprine pleuropneumonia), all subspecies Mycoplasma mycoides except subspecies mycoides small colony (Mmm SC) (contagious bovine pleuropneumonia), and any subtypes of Venezuelan equine encephalitis virus except for Subtypes IAB or IC, provided that the individual or entity can verify that the agent is within the exclusion category.

The following Standard operating procedure (SOP) intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any items listed in this SOP contact the Principal Investigator of your laboratory, your course director or the Office of Environmental Health and Safety (856-256-5105 or ehs@rowan.edu). Specific written procedures for a chemical or hazard are the responsibility of the principal investigator or course director.

If compliance with all the requirements of this SOP is not possible, the principal investigator/course director must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Hazardous gases: For the purposes of these guidelines gases that are flammable, toxic, corrosive, pyrophoric or oxidizing are considered hazardous gases.

A list of acutely toxic gases is included at the end of this SOP.

Definitions:

- CGA: Compressed Gas Association. A trade organization that promotes industry standards for manufacture, storage, transportation and use of compressed gases. The CGA sets standards for cylinder valve outlet connections.
- Two stage regulator: A device that reduces the higher pressure in the gas cylinder to a lower working pressure. Two stage regulators control pressure in two steps allowing precise control of pressure.
- Needle valve: A flow regulating device that allows fine control of gas flow and provides a secondary means of gas shut off.
- Purge assembly: A valving system that permits the flushing of the regulator and delivery tubing with inert gas.
- Flow restricting orifice: A flow limiting devices that restricts the maximum flow out of a compressed gas regulator. These devices are typically critical orifices.

Procedures and Practices

The use of hazardous gases by Rowan University Faculty, Students and Staff requires adherence to the following.

Ventilation: Proper ventilation is required in laboratories using hazardous compressed gases. The presence of a fume hood is mandatory (except for oxygen use) unless a gas cabinet and special local exhaust system or filtering system is used. Contact EHS to

determine if your lab has a ventilation system appropriate for hazardous gas use before purchasing the gas.

Cylinder Size: Use lecture sphere or bottle size hazardous gas sources in a returnable cylinder when small volumes are needed. While the initial purchase cost per cubic foot may be lower when hazardous gases are purchased in full sized cylinders the overall cost of experimental setup which may require local ventilation, gas cabinets, stainless steel piping and purging systems may off set the apparent saving from buying hazardous gases in full sized cylinders

Cylinder holders: All compressed gas cylinders, regardless of size, must be properly secured. Use floor or bench clamps or secure gases to the wall with chains installed by Facilities. A single floor or bench clamp may not be used to secure multiple cylinders unless it is designed for multiple cylinder support.

Regulators: Gases from full sized gas cylinders must be dispensed using a two stage regulator that is both compatible with the gas and the intended use. The maximum pressure of the second stage of the regulator should be a low as is practical for the intended experimental work. Do not select or reuse existing regulators with very high second stage pressure ranges unless needed since this will require the entire experimental setup (tubing, connections) to be engineered to withstand high pressures.

Flow control valves : A mechanical flow control valve (needle valve) that is compatible and properly cleaned for the hazardous gas must be attached directly to the gas out port of the gas regulator. This is required even if other flow control devices are present in the experimental device. Flow control must not be attempted through use of the gas regulator.

Flow restricting orifices : Where feasible flow restricting devices must be installed after the regulator. Select the appropriate flow restricting orifice based on gas used and the flow rate required for the research.

Tubing and piping : Hazardous gases must be dispensed using systems that are properly cleaned and compatible with the gas in use. Bust pressure of tubing and piping must exceed the maximum pressure on the second stage regulator. Exceptions to this requirement may be made for short sections of tubing when it and the compressed gas cylinder are completely enclosed in a fume hood and low pressures and flow rates are used.

Purge assembly : Required for all hazardous gas systems that are not used in a fume hood or other ventilated enclosure. Purge assemblies must exhaust into a fume hood or other approved exhaust system. Exceptions may be made for laser systems that contain small quantities of hazardous gas that will be effectively filtered when exhausted. Exemptions must be approved by EHS.

Vacuum pumps : Hydrocarbon based vacuum pump oil is incompatible with strongly oxidizing and many reactive gases. New vacuum pumps that have inert lubricants such as DuPont Krytox and never contained oil-based lubricants must be used with oxidizing and

reactive gases. Vacuum pumps must be securely vented to a fume hood or other approved exhaust system with tubing that is compatible with the gases used. Exhaust lines must be as short as feasible. Vented enclosures may be required for vacuum pumps depending on the toxicity of the gases used.

Leak testing : Hazardous gas systems must be leak tested using inert gas and leak detection solutions such as Snoop(TM) before use.

Securing of gas cylinders

Cylinders of compressed gases must be handled as high energy sources. When storing or moving a cylinder, have the cap securely in place to protect the stem. Use suitable racks, straps, chains or stands to support cylinders.

Decontamination procedures

Personnel: Wash hands and arms with soap and water immediately after handling acutely toxic gases.

Designated area

The room sign for the laboratory must contain a Designated Areas Within identifier where acutely toxic gases are used or stored.

All locations within the laboratory where acutely toxic gases are handled should be demarcated with designated area caution tape and/or posted with designated area caution signs. This includes all fume hoods and bench tops where the acutely toxic gases are handled.

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, should be developed by each laboratory. The procedures should address as a minimum the following:

- **Who to contact:** (Public Safety, Principal investigator/ course director of the laboratory including evening phone number and Office of Environmental Health and Safety)
- The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)
- The method used to alert personnel in nearby areas of potential hazards
- Special first aid treatment required by the type of acutely toxic material(s) handled in the laboratory

Fume hood

Manipulation of acutely toxic and hazardous gases should typically be carried out in a fume hood. All areas where acutely toxic or hazardous gases are stored or manipulated must be labeled as a designated area.

Glove (dry) box

Some processes involving acutely toxic gases may be performed in a properly vented glove box rather than a fume hood.

Hazard assessment

Hazard assessment should focus on the education of employees concerning the health risk posed by hazardous gases, on proper use and handling procedures, the demarcation of designated areas, and emergency evacuation and notification procedures in the event of a spill.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling hazardous gases.

The Principal Investigator/course director is responsible to the select the appropriate PPE.

The Office of Environmental Health and Safety is available to provide guidance.

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling acutely toxic or hazardous gases. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI/ISEA Z87.1-2010) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

Gloves

Gloves should be worn when handling hazardous gases. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of hazardous gases which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

The Principal Investigator/course director is responsible to the select the appropriate shielding.

The Office of Environmental Health and Safety is available to provide guidance.

Eyewash

Where the eyes or body of any person may be exposed to acutely toxic gases or hazardous gas, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the hazardous gases are used.

Signs and labels

- **Doorways:** The room sign must contain a Designated Area Within identifier where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used.
- **Containers:** All hazardous gas cylinders must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.

Special storage

Acutely toxic gases must be stored in a designated area. Special ventilation of the stored cylinders is required and must be approved by the Office of Environmental Health and Safety.
Continuous monitoring devices which will alert staff of a release of the acutely toxic gas is required for certain gases.

The quantity of an acutely toxic and hazardous gas that may be stored in a laboratory will be determined on a case-by-case basis by the Office of Environmental Health and Safety.

See the end of this procedure for a safety alert pertaining to hydrogen fluoride gas cylinders.

Special ventilation

Manipulation of acutely toxic gases outside of a fume hood will require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to hazardous in the laboratory and are the preferred ventilation control device. Always attempt to handle hazardous gases in a fume hood. If your research does not permit the handing of hazardous gases in your fume hood you must contact the Office of Environmental Health and Safety to review the adequacy of all special ventilation.

Spill response

In the event of an escape of gas alert personnel in the area that a spill has occurred. Do not attempt to handle a spill of acutely toxic or hazardous gases. Vacate the laboratory immediately and call for assistance.

- Public Safety 856-256-4911. This is a 24 hour service.
- Office of Environmental Health & Safety 856-256-5105 or ehs@rowan.edu.

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Not applicable

Waste disposal

All empty or partially filled hazardous gas cylinders should be returned to the supplier. If the supplier does not accept empty or partially filled cylinders, contact the Office of Environmental Health and Safety concerning disposal.

A list of Acutely Toxic Gases is provided below, as a guide. The list is not inclusive.

Principal Investigator/Course Director:_____

Laboratory Safety Officer:_____
(Principal Investigator/Course Director is the Laboratory Safety Officer is one is not assigned)

Building:_____ Room(s):_____

Completed By:_____ Date:_____

Where are the designated areas in your laboratory to work with the hazardous and highly toxic gases (list all hazardous and highly toxic gases):

Hazardous and Highly Toxic Gases	Designated Area Location (e.g., Chemical Fume Hood)

Acutely Toxic Gases

This list is provided as a guide and is not all inclusive. Review the Safety Data Sheet.

Name	CAS#	Name	CAS#
arsenic pentafluoride	784-36-3	oxygen difluoride	7783-41-7
arsine	7784-42-1	phosgene	75-45-5
boron trifluoride	7637-07-2	phosphine	1498-40-4
chlorine	7782-50-5	phosphorus pentafluoride	7641-19-0
diazomethane	334-88-3	selenium hexafluoride	7783-79-1
diborane	19287-45-7	silicon tetrafluoride	7783-61-1
fluorine	7681-49-4	stibine	10025-91-9
methyl mercaptan	74-93-1	sulfur tetrafluoride	7783-60-0

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If compliance with all the requirements of this SOP is not possible, the principal investigator or course director must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

A carcinogen commonly describes any agent that can initiate or speed the development of malignant or potentially malignant tumors, malignant neoplastic proliferation of cells, or cells that possess such material.

Securing of gas cylinders

Not applicable

Decontamination

- **Personnel:** Wash hands and arms with soap and water immediately after handling carcinogens.
- **Area:** Decontamination procedures vary depending on the material being handled. The toxicity of some materials can be neutralized with other reagents. All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling. Waste materials generated should be treated as a hazardous waste.
- **Equipment:** Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

Designated area

The room sign for the laboratory must contain a Designated Areas Within identifier.
All locations within the laboratory where carcinogens are handled should be demarcated with designated area caution tape and/or posted with designated area caution signs. This includes all fume hoods and bench tops where the carcinogens are handled.

Where feasible, carcinogens should be manipulated over plastic-backed disposable paper work surfaces. These disposable work surfaces minimize work area contamination and simplify clean up.

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, should be developed by each laboratory. The procedures should address as a minimum the following:

- **Who to contact:** (Public Safety, Principal investigator/course director of the laboratory including evening phone number, and Office of Environmental Health and Safety)
- The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)
- The method used to alert personnel in nearby areas of potential hazards
- Special first aid treatment required by the type of carcinogens handled in the laboratory
-

Fume hood

Manipulation of carcinogens should be carried out in a fume hood. If the use of a fume hood proves impractical refer to the section on special ventilation.

All areas where carcinogens are stored or manipulated must be labeled as a designated area.

Glove (dry) box

Certain carcinogens must be handled in a glove box rather than a fume hood. The Principal Investigator/course director is responsible to determine if this is required. EHS is available to provide guidance.

Hazard assessment

Hazard assessment should focus on proper use and handling techniques, education of laboratory workers concerning the health risks posed by carcinogens, and the demarcation of designated areas.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling carcinogens. Additional protective clothing should be worn if the possibility of skin contact is likely.

The Principal Investigator/Course Director is responsible to the select the appropriate PPE.

The Office of Environmental Health and Safety is available to provide guidance.

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling carcinogens. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI/ISEA Z87.1-2010) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

Gloves

Gloves should be worn when handling carcinogens. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals.

The Principal Investigator/Course Director is responsible to the select the appropriate chemical resistant glove when direct or prolonged contact with hazardous chemicals is anticipated.

The Office of Environmental Health and Safety is available to provide guidance.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of carcinogens which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

The Principal Investigator/Course Director is responsible to the select the appropriate shielding.

The Office of Environmental Health and Safety is available to provide guidance.

Eyewash

Where the eyes or body of any person may be exposed to carcinogens, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the carcinogens are used.

Signs and labels

- **Doorways:** The room sign must contain a Designated Area Within Caution where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used.
- **Containers:** All containers of carcinogens must be clearly labeled with the correct chemical name, and CAS #. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. Chemical containers must be dated upon receipt as well as when opened.

Special storage

Carcinogens must be stored in a designated area.

Special ventilation

Manipulation of carcinogens outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to carcinogens in the laboratory and are the preferred ventilation control device. When possible, handle carcinogens in a fume hood. If the use of a fume hood proves impractical, attempt to work in a glove box or on an isolated area on the bench top.

If available, consider using a Biological Safety Cabinet. The biological safety cabinet is designed to remove particulates (the carcinogen) before the air is discharged into the environment. Carcinogens that are volatile must not be used in a biological safety cabinet unless the cabinet is vented to the outdoors.

If your research does not permit the handling of carcinogens in a fume hood, biological safety cabinet, or glove box, you must contact the Office of Environmental Health Safety.

All areas where carcinogens are stored or manipulated must be labeled as a designated area.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Safety Data Sheet. This should occur prior to the use of any carcinogen.

In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of carcinogenic material. Vacate the laboratory immediately and call for assistance.

- Public Safety at 856-256-4911. This is a 24 hour service.
- Office of Environmental Health Safety, 856-256-5105 or ehs@rowan.edu

Remain on the scene, but at a safe distance, to receive and direct emergency personnel when they arrive.

Vacuum protection

Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving carcinogens must be conducted in a fume hood, glove box or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

Waste disposal

All materials contaminated with carcinogens should be disposed of as hazardous waste. Wherever possible, attempt to design research in a manner that reduces the quantity of waste generated. Questions regarding waste pick up should be directed to the Office of Environmental Health and Safety. This office can also assist you in minimizing waste generation.

A list of Suspected and Known Carcinogens is provided below, as a guide. The list is not inclusive.

LABORATORY SPECIFIC STANDARD OPERATING PROCEDURE
CARCINOGENS

Principal Investigator/Course Director:_____

Laboratory Safety Officer:_____
(Principal Investigator/Course Director is the Laboratory Safety Officer is one is not assigned)

Building:_____ Room(s):_____

Completed By:_____ Date:_____

Where are the designated areas in your laboratory to work with the carcinogens (list all carcinogens):

Carcinogens	Designated Area Location (e.g., Chemical Fume Hood)

List of Select and Suspected Carcinogens

This list is provided as a guide and is not all inclusive. Carefully review safety data sheets before working with chemicals.

Chemical Name	CAS
A-alpha-C (2-Amino-9H-pyrido{2,3-b]indole)	26148685
Acetaldehyde	76070
Acetamide	60355
Acetochlor	34256821
2-Acetylaminofluorene	53963
Acifluorfen	62476599
Acrylamide	79061
Acrylonitrile	107131
Actinomycin D	50760
Adriamycin (Doxorubicin hydrochloride)	23214928
AF-2; [2-(2-furyl)-3-(5-nitro-2-furyl)]acrylamide	3588537
Aflatoxins	----
Alachlor	15972608
Aldrin	309002
Allyl chloride	107051
2-Aminoanthraquinone	117793
p-Aminoazobenzene	60093
ortho-Aminoazotoluene	97563
4-Aminobiphenyl (4-aminodiphenyl)	92671
3-Amino-9-ethylcarbazole hydrochloride	6109973

Chemical Name	CAS
1-Amino-2-methylanthraquinone	82280
2-Amino-5-(5-nitro-2-furyl)-1,3,4-thiadiazole	712685
Amitrole	61825
Aniline	62533
ortho-Anisidine	90040
ortho-Anisidine hydrochloride	134292
Antimony oxide (Antimony trioxide)	130964
Aramite	140578
Arsenic (inorganic arsenic compounds)	---
Asbestos	1332214
Auramine	492808
Azaserine	115026
Azathioprine	446866
Azacitidine	320672
Azobenzene	103333
Benz[a]anthracene	56553
Benzene	71432
Benzidine [and its salts]	92875
Benzo [b] fluoranthene	205992
Benzo [j] fluoranthene	205823
Benzo [k] fluoranthene	207089
Benzofuran	271896

Chemical Name	CAS
Benzo [a] pyrene	50328
Benzotrichloride	98077
Benzyl chloride	100447
Benzyl violet 4B	1694093
Beryllium and beryllium compounds	---
Betel quid with tobacco	---
Bis(2-chloroethyl)ether	111444
N,N,-Bis(2-chloroethyl)-2-naphthylamine (Chlornapazine)	494031
Bischloroethyl nitrosourea (BCNU) (Carmustine)	154938
Bis (chloromethyl) ether	542881
Bitumens, extracts of steam-refined and air-refined	---
Bracken fern	---
Bromodichloromethane	75274
Bromoform	75252
1,3-Butadiene	106990
1,4-Butanediol dimethanesulfonate (Busulfan)	55981
Butylated hydroxyanisole	25013165
vbeta-Butyrolactone	3068880
Cadmium and cadmium compounds	---
Captafol	2425061
Captan	133062
Carbon tetrachloride	56235

Chemical Name	CAS
Carbon-black extracts	---
Ceramic fibers	---
Chlorambucil	305033
Chloramphenicol	56757
Chlordane	57749
Chlordecone (Kepone)	143500
Chlordimeform	115286
Chlorendic acid	115286
Chlorinated paraffins	108171262
Chlorodibromethane	124481
Chloroethane (Ethyl chloride)	75003
1-(2-Chloroethyl)-3-cyclohexyl-1-nitrosourea	13010474
1-(2-Chloroethyl)-3-(4-methylcyclohexyl)-1-nitrosourea (Methyl-CCNU)	13909096
Chloroform	67663
Chloromethyl methyl ether	107302
3-Chloro-2-methylpropene	563473
4-Chloro-ortho-phenylenediamine	95830
p-Chloro-o-toluidine	95692
Chlorothalonil	1897456
Chlorozotocin	54749905
Chromium (hexavalent)	---
Chrysene	18019

Chemical Name	CAS
C. I. Acid Red 114	6459945
C. I. Basic Red 9 monohydrochloride	569619
Ciclosporin (Cyclosporin A; Cyclosporine)	59865133;79217600
Cinnamyl anthranilate	87296
Cisplatin	15663271
Citrus Red No. 2	6358538
Cobalt metal powder	7440484
Cobalt [II] oxide	1307966
Conjugated estrogens	---
Creosotes	---
para-Cresidine	120718
Cupferron	135206
Cycasin	14901087
Cyclophosphamide (anhydrous)	50180
Cyclophosphamide (hydrated)	6055192
D&C Orange No. 17	46831
D&C Red No. 8	2092560
D&C Red No. 9	5160021
D&C Red No. 19	81889
Dacarbazine	4342034
Daminozide	1596845
Dantron (Chrysazin; 1,8-Dihydroxyanthraquinone)	117102

Chemical Name	CAS
Daunomycin	20830813
DDD (Dichlorodiphenyldichloroethane)	72548
DDE (Dichlorodiphenyldichloroethylene)	72559
DDT (Dichlorodiphenyltrichloroethane)	50293
DDVP (Dichlorvos)	62737
N,N'-Diacetylbenzidine	613354
2,4-Diaminoanisole	615054
2,4-Diaminoanisole sulfate	39156417
4,4'-Diaminodiphenyl ether (4,4'-Oxydianiline)	101804
2,4-Diaminotoluene	95807
Diaminotoluene (mixed)	---
Dibenz[a,h]acridine	226368
Dibenz[a,j]acridine	224420
Dibenz[a,h]anthracene	53703
7H-Dibenzo[c,g]carbazole	194592
Dibenzo[a,e]pyrene	192654
Dibenzo[a,h]pyrene	189640
Dibenzo[a,i]pyrene	189559
Dibenzo[a,l]pyrene	191300
1,2-Dibromo-3-chloropropane (DBCP)	96128
p-Dichlorobenzene	106467
3,3'-Dichlorobenzidine	91941

Chemical Name	CAS
1,4-Dichloro-2-butene	764410
3,3'-Dichloro-4,4'-diaminodiphenyl ether	28434868
1,1-Dichloroethane	75343
Dichloromethane (Methylene chloride)	75092
1,2-Dichloropropane	78875
1,3-Dichloropropene	542756
Dieldrin	60571
Dienestrol	84173
Diepoxybutane	1464535
Diesel engine exhaust	---
Di(2-ethylhexyl)phthalate	117817
1,2-Diethylhydrazine	1615801
Diethyl sulfate	64675
Diethylstilbestrol	56531
Diglycidyl resorcinol ether (DGRE)	101906
Dihydrosafrole	94586
3,3'-Dimethoxybenzidine (ortho-Dianisidine)	119904
3,3'-Dimethoxybenzidine dihydrochloride (ortho-Dianisidine dihydrochloride)	20325400
Dimethylcarbamoyl chloride	79447
1,1-Dimethylhydrazine (UDMH)	57147
1,2-Dimethylhydrazine	540738
Dimethylvinylchloride	513371

Chemical Name	CAS
1,6-Dinitropyrene	42397648
1,8-Dinitropyrene	42397659
2,4-Dinitrotoluene	121142
1,4-Dioxane	123911
Diphenylhydantoin (Phenytoin)	57410
Diphenylhydantoin (Phenytoin), sodium salt	630933
Direct Black 38 (technical grade)	1937377
Direct Blue 6 (technical grade)	2602462
Direct Brown 95 (technical grade)	16071866
Disperse Blue 1	2475458
Epichlorohydrin	106898
Erionite	12510428
Estradiol 17β	50282
Estrone	53167
Ethinylestradiol	57636
Ethyl acrylate	140885
Ethyl methanesulfonate	62500
Ethyl-4-4'-dichlorobenzilate	510156
Ethylene dibromide	106934
Ethylene dichloride (1,2-Dichloroethane)	107062
Ethylene oxide	75218
Ethylene thiourea	96457

Chemical Name	CAS
Ethyleneimine	151564
Folpet	133073
Formaldehyde	50000
2-(2-Formylhydrazino)-4-(5-nitro-2-furyl)thiazole	3570750
Furazolidone	67458
Furmecyclox	60568050
Glu-P-1 (2-Amino-6-methyldipyrido[1,2-a:3',2'- d]imidazole)	67730114
Glycidaldehyde	765344
Glycidol	556525
Griseofulvin	126078
Gyromitrin (Acetaldehyde methylformylhydrazone)	16568028
HC Blue 1	2784943
Heptachlor	76448
Heptachlor epoxide	1024573
Hexachlorobenzene	118741
Hexachlorocyclohexane (technical grade)	---
Hexachlorodibenzodioxin	34465468
Hexachloroethane	67721
Hexamethylphosphoramide	680319
Hydrazine	302012
Hydrazine sulfate	10034932
Hydrazobenzene (1,2-Diphenylhydrazine)	122667

Chemical Name	CAS
Indeno [1,2,3-cd]pyrene	193395
IQ (2-Amino-3-methylimidazp[4,5-f]quinoline)	76180966
Iron dextran complex	9004664
Isosafrole	120581
Lactofen	77501634
Lasiocarpine	303344
Lead acetate	301042
Lead phosphate	7446277
Lead subacetate	1335326
Lindane	---
Mancozeb	8018017
Maneb	12427382
Me-A-alpha-C (2-Amino-3-methyl-9H-pyrido[2,3-b]indole)	68005837
Medroxyprogesterone acetate	71589
Melphalan	148823
Merphalan	531760
Mestranol	72333
8-Methoxypsoralen with ultraviolet A therapy	298817
5-Methoxypsoralen with ultraviolet A therapy	484208
2-Methylaziridine (Propyleneimine)	75558
Methylazoxymethanol	590965
Methylazoxymethanol acetate	592621

Chemical Name	CAS
3-Methylcholanthrene	56495
5-Methylchrysene	3697243
4,4'-Methylene bis(2-chloroaniline)	101144
4,4'-Methylene bis(N,N-dimethyl)benzenamine	101611
4,4'-Methylene bis(2-methylaniline)	838880
4,4'-Methylenedianiline	01779
4,4'-Methylenedianiline dihydrochloride	13552448
Methylhydrazine and its salts	13552448
Methyl iodide	74884
Methyl methanesulfonate	66273
2-Methyl-1-nitroanthraquinone	129157
N-Methyl-N'-nitro-N-nitrosoguanidine	70257
N-Methylolacrylamide	924425
Methylthiouracil	56042
Metiram	9005422
Metronidazole	443481
Michler's ketone	90948
Mirex	2385855
Mitomycin C	50077
Monocrotaline	315220
5-(Morpholinomethyl)-3-[(5-nitro-furfurylidene)-amino]-2 -oxalolidinone	139913
Mustard Gas	505602

Chemical Name	CAS
Nafenopin	3771195
1-Naphthylamine	124327
2-Naphthylamine	91598
Nickel and certain nickel compounds	---
Nickel carbonyl	13463393
Nickel subsulfide	12035722
Niridazole	61474
Nitrilotriacetric acid	139139
Nitrilotriacetric acid, trisodium salt monohydrate	18662538
5-Nitroacenaphthene	602879
5-Nitro-o-anisidine	99592
4-Nitrobiphenyl	93933
6-Nitrochrysene	7496028
Nitrofen (technical grade)	1836755
2-Nitrofluorene	607578
Nitrofurazone	59870
1-[5-Nitrofurfurylidene)-amino]-2-imidazolidinone	555840
N-[4-(5-Nitro-2-furyl)-2-thiazolyl]acetamide	531828
Nitrogen mustard (Mechlorethamine)	51752
Nitrogen mustard hydrochloride (Mechlorethamine hydrochloride)	55867
Nitrogen mustard N-oxide	126852
Nitrogen mustard N-oxide hydrochloride	302705

Chemical Name	CAS
2-Nitropropane	79469
1-Nitropyrene	5522430
4-Nitropyrene	57835924
N-Nitrosodi-n-butylamine	924163
N-Nitrosodiethanolamine	1116547
N-Nitrosodiethylamine	55185
N-Nitrosodimethylamine	62759
p-Nitrosodiphenylamine	156105
N-Nitrosodiphenylamine	86306
N-Nitrosodi-n-propylamine	621647
N-Nitroso-N-ethylurea	759739
3-(N-Nitrosomethylamino)propionitrile	60153493
4-(N-Nitrosomethylamino)-1-(3-pyridyl)1-butanone	64091914
N-Nitrosomethylethylamine	10595956
N-Nitroso-N-methylurea	684935
N-Nitroso-N-methylurethane	615532
N-Nitrosomethylvinylamine	4549400
N-Nitrosomorpholine	59892
N-Nitrosonornicotine	16543558
N-Nitrosopiperidine	100754
N-Nitrosopyrrolidine	930552
N-Nitrososarcosine	13256229

Chemical Name	CAS
Norethisterone (Norethindrone)	68224
Ochratoxin A	303479
Oxadiazon	19666309
Oxymetholone	434071
Panfuran S	---
Pentachlorophenol	87865
Phenacetin	62442
Phenazopyridine	94780
Phenazopyridine hydrochloride	136403
Phenesterin	3546109
Phenobarbital	50066
Phenoxybenzamine	59961
Phenoxybenzamine hydrochloride	63923
Phenyl glycidyl ether	22601
Phenylhydrazine and its salts	---
o-Phenylphenate, sodium	132274
Polybrominated biphenyls	---
Polychlorinated biphenyls	---
Polygeenan	53973981
Ponceau MX	3761533
Ponceau 3R	3564098
Potassium bromate	7758012

Chemical Name	CAS
Procarbazine	671169
Procarbazine hydrochloride	366701
Progesterone	57830
1,3-Propane sultone	1120714
beta-Propiolactone	57578
Propylene oxide	75569
Propylthiouracil	51525
Reserpine	50555
Saccharin	81072
Saccharin, sodium	128449
Safrole	94597
Selenium sulfide	7446346
Silica, crystalline	---
Streptozotocin	18883664
Styrene oxide	96093
Sulfallate	95067
Talc[illegible] containing asbestiform fibers	---
Testosterone and its esters	58220
2,3,7,8-Tetrachlorodibenzo-para-dioxin (TCDD)	1746016
1,1,2,2-Tetrachloroethane	79345
Tetrachloroethylene (Perchloroethylene)	127184
p-a, a, a-Tetrachlorotoluene	5216251

Chemical Name	CAS
Tetranitromethane	509148
Thioacetamide	62555
4,4’ - Thiodianiline	139651
Thiourea	62566
Thorium dioxide	1314201
Toluene diisocyanate	26471625
ortho-Toluidine	95534
ortho-Toluidine hydrochloride	636215
para-Toluidine	106490
Toxaphene (Polychorinated camphenes)	8001352
Trasulfan	299752
Trichlormethine (Trimustine hydrochloride)	817094
2,4,6-Trichlorophenol	88062
Triphenyltin hydroxide	76879
Trichloroethylene	79016
Tris (aziridinyl)-para-benzoquinone (Triaziquone)	68768
Tris (1-aziridinyl) phosphine sulfide (Thiotepa)	52244
Tris (2-chloroethyl) phosphate	115968
Tris (2,3-dibromopropyl) phosphate	126727
Trp-P-1 (Tryptophan-P-1)	62450060
Trp-P-2 (Tryptophan-P-2)	62450071
Trypan blue (commercial grade)	72571

Chemical Name	CAS
Uracil mustard	66751
Urethane (Ethyl carbamate)	51796
Vinyl bromide	593602
Vinyl chloride	75014
4-Vinyl-1-cyclohexene diepoxide (Vinyl cyclohexene dioxide)	106876
Vinyl trichloride (1,1,2-Trichloroethane)	79005
2,6-Xylidine (2,6-Dimethylaniline)	87627
Zineb	12122677

The following Standard operating procedure (SOP) is intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this SOP, contact the Principal Investigator of your laboratory, course director or Office of Environmental Health and Safety (856-256-5105 or ehs@rowan.edu). Specific written procedures are the responsibility of the principal investigator/course director.

If compliance with all the requirements of this SOP is not possible, the principal investigator/Course Director must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Additional requirements may apply if the materials is a highly toxic compressed gas. Please refer to the SOP for Hazardous and Highly Toxic Gases if applicable.

Labeling Compressed Gas Cylinders

Gas cylinders must be labeled as to their contents. Compressed gas cylinders should not be received from the vendor if they are not properly labeled. It is the responsibility of the principal investigator/course director to re-label the compressed gas cylinder if the label is fading, deteriorating or not fully legible.

Securing of gas cylinders

Cylinders of compressed gases must be handled as high energy sources. They pose a serious hazard if the cylinder valve is dislodged. When storing or moving a cylinder, have the cap securely in place to protect the stem. Use suitable racks, straps, chains or stands to support cylinders.

Do not store cylinders or lecture bottles with the regulator in place. If the regulator fails, the entire contents of the gas cylinder may be discharged.

Decontamination procedures

Not Applicable

Designated area

Compressed gas cylinders which contain acutely toxic gases must be stored in a designated area. See the SOP for Hazardous and Highly Toxic compressed gases.

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, should be developed by each laboratory. The procedures should address as a minimum the following:

- **Who to contact:** (University police, Principal investigator/course director of the laboratory including evening phone number and Office of Environmental Health Safety)
- The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)
- The method used to alert personnel in nearby areas of potential hazards
- Special first aid treatment required by the type of compressed gas handled in the laboratory

Fume hood

Manipulation of compressed gases should typically be carried out in a fume hood if the compressed gas is an irritant, oxidizer, asphyxiant or has other hazardous properties.

Glove (dry) box

Not applicable

Gloves

Not applicable

Hazard assessment

Hazard assessment for work with compressed gases should assure that all staff understand proper use and handling precautions; that all pressurized equipment is properly shielded; regulators are not interchanged between different gas types; all hose connections are properly secured and are appropriate for the pressure(s) used.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling compressed gases.

The Principal Investigator/course director is responsible to the select the appropriate PPE.

The Office of Environmental Health and Safety is available to provide guidance.

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling compressed gases. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI/ISEA Z87.1-2010) and must be equipped with side shields.

The Principal Investigator/course director is responsible to the select the appropriate PPE.

The Office of Environmental Health and Safety is available to provide guidance.

Gloves

Not applicable

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of compressed gases which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

The Principal Investigator/course director is responsible to the select the appropriate shielding.

The Office of Environmental Health and Safety is available to provide guidance.

Eyewash

Suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the carcinogens are used.

Signs and labels

Containers: All compressed gases must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. The compressed gas cylinder should be labeled to indicate if the container is full or empty.

Special storage

Cylinders shall be stored in an upright position and secured to a wall, floor or laboratory bench through the use of appropriate cylinder supports. When using commercial cylinder supports, do not secure more cylinders than the support was designed for. It is preferable that cylinder supports be purchased from Rowan University-approved compressed gas or scientific supply vendors. Cylinder supports installed by Facilities secured to the wall at two and four feet above the floor using fasteners appropriate for the wall construction and weight of cylinders to be secured. Each shall have a section of chain that securely attaches to the strut at two points. When the chain is attached to the strut it must fit snuggly around the cylinders.

Cylinder caps should remain on the cylinder at all times unless a regulator is in place. Cylinders should be stored in areas where they will not become overheated and overcrowded. Avoid storage near radiators, areas in direct sunlight, steam pipes and heat releasing equipment such as sterilizers.

Transport compressed gas cylinders on equipment designed for this function. Never carry or "walk" cylinders by hand. They must be transported on chain-equipped hand trucks or carts. Never roll or drag cylinders.

Special ventilation

Manipulation of compressed gas that is an irritant, oxidizer, asphyxiant, or has other hazardous properties outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to compressed gases in the laboratory and are the preferred ventilation control device. If you have questions contact the Office of Environmental Health and Safety to review the adequacy of all special ventilation.

Leak response

In the event of a leak of a compressed gas that is an irritant, oxidizer, asphyxiant, or has other hazardous properties all personnel in the area should be alerted. Vacate the laboratory immediately and call for assistance.

- University Police 856-256-4911. This is a 24 hour service.
- Office of Environmental Health Safety, 856-256-5105 or ehs@rowan.edu

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Not applicable

Waste disposal

All empty or partially filled compressed gas cylinders should be returned to the supplier. If the supplier does not accept empty or partially filled cylinders, contact the Office of Environmental Health and Safety concerning disposal.

Principal Investigator/Course Director:_____

Laboratory Safety Officer:_____
(Principal Investigator/Course Director is the Laboratory Safety Officer if one is not assigned)

Building:_____ Room(s):_____

Completed By:_____ Date:_____

Where are the designated areas in your laboratory to work with/store compressed gases (list all compressed gases)

Compressed Gas	Designated Area Location

The following Standard operating procedure (SOP) is intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this SOP contact the Principal Investigator of your laboratory, course director or the Office of Environmental Health and Safety (856-256-5105 or ehs@rowan.edu). Specific written procedures are the responsibility of the principal investigator/course director.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Oxidizing chemicals are materials that spontaneously evolve oxygen at room temperature or with slight heating or promote combustion. This class of chemicals includes peroxides, chlorates, perchlorates, nitrates, and permanganates. Strong oxidizers are capable of forming explosive mixtures when mixed with combustible, organic or easily oxidized materials.

Examples of strong oxidizers are listed at the end of this SOP.

Securing of gas cylinders

Not applicable

Decontamination procedures

Personnel: Wash hands and arms with soap and water immediately after handling oxidizing chemicals.
Area: Carefully clean work area after use. Paper towels or similar materials contaminated with strong oxidizing chemicals may pose a fire risk.

Designated area

Not applicable

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, should be developed by each laboratory. The procedures should address as a minimum the following:

- **Who to contact:** (University police, Principal investigator of the laboratory including evening phone number and Office of Environmental Health and Safety,)
- The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.)
- The method used to alert personnel in nearby areas of potential hazards
- Special first aid treatment required by the type of oxidizing chemicals material(s) handled in the laboratory

Fume hood

The use of certain concentrations of perchloric acid must be performed in a fume hood equipped with wash down facilities. Contact the Office of Environmental Health and Safety for fume hood requirements.

Glove (dry) box

Not applicable

Hazard assessment

Hazard assessment should address proper use and handling techniques, fire safety, storage, and waste disposal issues.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling oxidizing chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

The Principal Investigator/Course Director is responsible to the select the appropriate PPE

The Office of Environmental Health and Safety is available to provide guidance.

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling oxidizing chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI/ISEA Z87.1-2010) and must be equipped with side shields. Safety glasses with side shields do not

provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

The Principal Investigator/Course Director is responsible to the select the appropriate eye protection.

The Office of Environmental Health and Safety is available to provide guidance.

Gloves

Gloves should be worn when handling oxidizing chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. The Principal Investigator is responsible to the select the appropriate chemical resistant glove when direct or prolonged contact with hazardous chemicals is anticipated.

The Principal Investigator/Course Director is responsible to the select the appropriate glove.

The Office of Environmental Health and Safety is available to provide guidance.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of oxidizing chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

The Principal Investigator/Course Director is responsible to the select the appropriate shielding.

The Office of Environmental Health and Safety is available to provide guidance.

Eyewash

Where the eyes or body of any person may be exposed to oxidizing chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the oxidizing chemicals are used.

Signs and labels

Containers: All water reactive chemicals chemical must be clearly labeled with the correct chemical name, health hazard and CAS#. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. Chemical containers must be dated upon receipt as well as when opened.

Special storage

Oxidizers should be stored in a cool and dry location. Keep oxidizers segregated from all other chemicals in the laboratory. Minimize the quantities of strong oxidizers stored in the laboratory.

Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

Special ventilation

The use of certain concentrations of perchloric acid must be performed in a fume hood equipped with wash down facilities. Contact the Office of Environmental Health and Safety for fume hood requirements.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any oxidizing chemicals. Spill control materials for oxidizers are designed to be inert and will not react with the reagent. Never use paper towels or other inappropriate materials which are combustible. The waste materials generated during spill cleanup may pose a flammability risk and should not remain in the laboratory overnight unless it is stored in an appropriate container.

In the event of a spill. Alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of oxidizing chemicals. Vacate the laboratory immediately and call for assistance.

- University Police 856-256-4911. This is a 24 hour service.
- Office of Environmental Health Safety, 856-256-5105 or ehs@rowan.edu

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving oxidizing chemicals must be conducted in a fume hood, glove box or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

Waste disposal

All materials contaminated with oxidizing chemicals pose a fire hazard and should be disposed of as hazardous waste. Do not let contaminated wastes remain in the laboratory overnight unless proper containers are provided.

Chemicals that contain hydrogen peroxide, other strong oxidizers, and/or highly reactive chemicals require special waste-disposal procedures.

STRONG OXIDIZERS

Principal Investigator/Course Director:_____

Laboratory Safety Officer:_____
(Principal Investigator/Course Director is the Laboratory Safety Officer if one is not assigned)

Building:_____ Room(s):_____

Completed By:_____ Date:_____

Where are the designated areas in your laboratory to work with the acutely toxic chemicals (list all acutely toxic chemicals):

Strong Oxidizers	Designated Area Location (e.g., Chemical Fume Hood)

Examples of Strong Oxidizers

Ammonium perchlorate	Ammonium permanganate
Barium peroxide	Bromine
Calcium chlorate	Calcium hypochlorite
Chlorine trifluoride	Chromium anhydride
Chromic acid	Dibenzoyl peroxide
Fluorine	Hydrogen peroxide
Magnesium peroxide	Nitrogen trioxide
Perchloric acid	Potassium bromate
Potassium chlorate	Potassium peroxide
Propyl nitrate	Sodium chlorate
Sodium chlorite	Sodium perchlorate
Sodium peroxide	

Source: CRC Handbook of Laboratory Safety, 3rd edition.

The following Standard operating procedure (SOP) is intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this SOP contact the Principal Investigator of your laboratory, course director or Office of Environmental Health and Safety (856-256-5105 or ehs@rowan.edu). Specific written procedures are the responsibility of the principal investigator.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator/course director must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Pyrophoric chemicals are liquids, solids, and gases that will ignite spontaneously in air at or below 130 °F.

Gas cylinders

Cylinders of compressed pyrophoric gases must be handled as high energy sources. When storing or moving a cylinder, have the cap securely in place to protect the stem. Use suitable racks, straps, chains or stands to support cylinders.

The use of pyrophoric gases requires EHS approval. If you anticipate the need to use pyrophoric gases in your work the Office of Environmental Health and Safety is available to provide guidance.

Supervision and Training

All users of pyrophoric reagents in the laboratory must receive hands-on instruction from the Principal Investigator or Post-Doctoral Fellow and must be closely supervised until safe work practices are consistently demonstrated. This training must be documented so that proof of training is available upon request. The training documentation form is attached to this SOP.

- This video from UCLA is recommended as a training aid; however, it may not be used as a substitute for hands-on demonstration and instruction.

- The Sigma-Aldrich Technical Bulletins "Handling of Air-Sensitive Reagents (AL-134)" and "The Aldrich Sure/Pac™ System (AL-136)" provide further guidance.

Hazard assessment

Hazard assessment for work involving pyrophoric chemicals should thoroughly address the issue of fire safety (including the need for Class D fire extinguishers), proper use and handling techniques, chemical toxicity, storage, and spill response.

Contact EHS if you would like assistance in performing a thorough hazard assessment prior to starting your work.

Engineering Controls

Ventilation

Always handle liquid pyrophoric chemicals in a fume hood or glove box. If your research does not permit the handing of pyrophoric chemicals in a fume hood or glove box you must contact the Office of Environmental Health and Safety to review the adequacy of all special ventilation.

Fume hood

Many pyrophoric chemicals release noxious or flammable gases and should be handled in a hood. In addition some solid pyrophoric materials are stored under kerosene (or other flammable solvents), therefore the use of a fume hood is required to prevent the release of flammable vapors in the laboratory. Glove boxes may be also be used (see special ventilation).

Glove (dry and inert) box

Glove boxes must be used to handle pyrophoric chemicals if sufficient inert or dry atmospheres cannot be achieved using a vacuum gas manifold.

Gas Cabinet

Ventilated compressed gas cylinder storage cabinets may be required for high hazard gases such as pyrophorics. Consult EHS before purchasing any pyrophoric gases.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of pyrophoric chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible Portable shields, which provide protection to all laboratory occupants are acceptable.

The Principal Investigator/Course Director is responsible to the select the appropriate shielding

The Office of Environmental Health and Safety is available to provide guidance.

Vacuum protection

Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving pyrophoric chemicals must be conducted in a fume hood or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood. Vacuum pumps should be rated for use with pyrophoric chemicals.

Personal Protective Equipment

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling pyrophoric chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

Unless work will be performed in a glove box, it is highly recommended that a Nomex lab coat be worn while manipulating quantities of liquid pyrophorics over 10 mL or solid pyrophorics over 1 gram.

The Principal Investigator/Course Director is responsible to the select the appropriate PPE.

The Office of Environmental Health and Safety is available to provide guidance.

Gloves

Gloves should be worn when handling pyrophoric chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals, but are highly combustible. Consider the use of Nomex/Leather pilot's gloves, which provide fire resistance without compromising manual dexterity. The pilots gloves should be worn over nitrile gloves and are required during syringe/cannula transfers of pyrophoric liquids.

The Principal Investigator/Course Director is responsible to the select the appropriate chemical resistant gloves.

The Office of Environmental Health and Safety is available to provide guidance.

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling pyrophoric chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the

Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

The Principal Investigator/Course Director is responsible to the select the appropriate eye protection.

The Office of Environmental Health and Safety is available to provide guidance.

Emergencies

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, should be developed by each laboratory. The procedures should address as a minimum the following:

- **Who to contact:** (University police, Principal investigator/Course Director of the laboratory including evening phone number, and EHS)
- The location of all safety equipment (showers, eye wash, fire extinguishers, spill clean-up materials, etc.)
- The method used to alert personnel in nearby areas of potential hazards
- Special spill control materials based on the specific pyrophoric chemical handled.

Eyewash

Where the eyes or body of any person may be exposed to pyrophoric chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable. Eyewashes should be activated by lab personnel weekly.

Safety shower

A safety or drench shower should be available in a nearby location where the pyrophoric chemicals are used. Researchers should familiarize themselves with the location of the two nearest safety showers and eyewash stations both in and outside the lab prior to beginning work with pyrophoric materials.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any pyrophoric chemicals. Spill control materials for pyrophoric chemicals are designed to be inert and will not react with the reagent.

Many pyrophoric reagents must not be extinguished using a CO_2 fire extinguisher. Sand or soda ash (powdered lime) should be readily available where work is performed. Also, a small beaker of sand can be used to safely extinguish any small fires occurring at the tips of needles used to transfer liquid pyrophorics.

In the event of a spill alert personnel in the area. Do not attempt to clean-up a large spill of pyrophoric chemicals. Turn off all ignition sources and vacate the laboratory immediately. Call for assistance.

- University Police 856-256-4911. This is a 24 hour service.
- Office of Environmental Health Safety, 856-256-5105 or ehs@rowan.edu

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Storage and Disposal

Signs and labels

Containers: All pyrophoric chemicals must be clearly labeled with the correct chemical name, hazard information and CAS#. Pyrophoric chemicals should always be stored in their original commercial container. Chemical containers must be dated upon receipt as well as when opened.

Special storage

Pyrophoric chemicals should be stored under an atmosphere of inert gas or under an appropriate liquid. Do not store pyrophoric chemicals with flammable materials or in a flammable-liquids storage cabinet. Store these materials away from sources of ignition. Minimize the quantities of pyrophoric chemicals stored in the laboratory. Store bottles of liquid pyrophorics inside the original metal shipping can, if available, to provide additional protection/secondary containment.
Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

Date containers upon initial receipt and upon opening. Take note of any printed expiration dates on the container label and dispose of them as required. Many pyrophoric reagents become unstable or more dangerous with age.

Purchase pyrophoric reagents in the minimum quantity required for the work to be performed. Initial cost per volume/weight may be lower when reagents are purchased in bulk, but repeated opening of containers and puncturing of septa leads to product degradation and loss. Wasted material and disposal cost will often offset any initial savings.

Designated area

Any area where pyrophoric reagents will be handled must be carefully prepared prior to starting work. All equipment and materials needed for the experiment should be readily available, including appropriate extinguishing media. The work area should be clear of reagents and equipment not pertinent to the current experiment, including flammable and combustible reagents and materials.

Other lab occupants should be made aware when and where work with hazardous materials will be performed.

Waste disposal

Mixtures of chemicals such as reaction mixtures containing pyrophoric reagents should be carefully and completely quenched before combining with waste or packaging for disposal. Empty septa-sealed pyrophoric reagent containers (such as Sure-Seal™ bottles) will be disposed of through the hazardous waste vendor at Rowan University. There is no need to quench or rinse these containers.

Expired or unused reagent will be disposed of in the original commercial bottle through the hazardous waste vendor at Rowan University. There is no need to empty, quench, or rinse these containers.

Principal Investigator/Course Director:_____

Laboratory Safety Officer:_____
(Principal Investigator/Course Director is the Laboratory Safety Officer if one is not assigned)

Building:_____ Room(s):_____

Completed By:_____ Date:_____

Where are the designated areas in your laboratory to work with the acutely toxic chemicals (list all acutely toxic chemicals):

Pyrophoric Chemicals	Designated Area Location (e.g., Chemical Fume Hood)

The following Standard Operating Procedure (SOP) is intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this SOP contact the Principal Investigator of your laboratory, Course Director or the Office of Environmental Health and Safety (856-256-5105 or ehs@rowan.edu). Specific written procedures are the responsibility of the principal investigator/course director.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator/course director must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Reactive liquids are chemicals that react vigorously with moisture or oxygen or other substances.

Securing of gas cylinders

Not applicable

Decontamination procedures

- **Personnel:** Wash hands and arms with soap and water immediately after handling reactive liquids.
- **Area:** Carefully clean work area after use.
- **Equipment:** Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

Designated area

Not applicable

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, should be developed by each laboratory. The procedures should address as a minimum the following:

- **Who to contact:** (University police, Principal investigator/Course Director of the laboratory including evening phone number and EHS)

- The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.)
- The location and quantity of all reactive liquids in the laboratory
- The method used to alert personnel in nearby areas of potential hazards
- Special first aid treatment required by the type of reactive liquids handled in the laboratory

Fume hood

Many reactive liquids will ignite or liberate combustible gas when exposed to water vapor or air. The use of a fume hood is recommended to prevent the buildup of flammable gases.

Glove (dry) box

A glove box may be used to handle reactive liquids if an inert or dry atmosphere is required.

Hazard assessment

Hazard assessment of work involving reactive liquids should address proper use and handling techniques, fire safety (including the need for Class D fire extinguishers), storage, the specific reactive nature of the material (such as water and air reactivity), and waste disposal issues.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling reactive liquids. Additional protective clothing should be worn if the possibility of skin contact is likely.

The Principal Investigator/Course Director is responsible to the select the appropriate PPE.

The Office of Environmental Health and Safety is available to provide guidance.

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling reactive liquids. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI/ISEA Z87.1-2010) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

The Principal Investigator/Course Director is responsible to select the appropriate eye protection.

The Office of Environmental Health and Safety is available to provide guidance.

Gloves

Gloves should be worn when handling reactive liquids. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals.

The Principal Investigator/Course Director is responsible to the select the appropriate chemical resistant glove when direct or prolonged contact with hazardous chemicals is anticipated.

The Office of Environmental Health and Safety is available to provide guidance.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of reactive liquids that pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants are acceptable.

The Principal Investigator/Course Director is responsible to the select the appropriate shielding.

The Office of Environmental Health and Safety is available to provide guidance.

Eyewash

Where the eyes or body of any person may be exposed to reactive liquids, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the reactive liquids are used.

Signs and labels

Containers: All reactive liquids must be clearly labeled with the correct chemical name, health hazard and CAS#. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. Chemical containers must be dated upon receipt as well as when opened.

Special storage

Reactive liquids should be stored in a cool and dry location. Keep reactive liquids segregated from all other chemicals in the laboratory. Minimize the quantities of reactive liquids stored in the laboratory.

Date all containers upon receipt. Examine storage containers frequently. Dispose of any container that exhibits salt build up on its exterior. Dispose of all reactive liquids whenever they are no longer required for current research.

Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container that may cause a fire or explosion.

Special ventilation

Special ventilation may be required if these materials are used outside a fume hood. If your research does not permit the handing of reactive liquids in a fume hood you must contact the Office of Environmental Health and Safety to review the adequacy of all special ventilation.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Safety Data Sheet. This should occur prior to the use of any reactive liquids. Spill control materials for reactive liquids are designed to be inert and will not react with the reagent.

In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a spill of reactive liquids. Turn off all ignition sources and vacate the laboratory immediately. Call for assistance.

- University Police 856-256-4911. This is a 24 hour service.
- Office of Environmental Health & Safety 856-256-5105 or ehs@rowan.edu

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Not applicable

Waste disposal

All materials contaminated with reactive liquids should be disposed of as hazardous waste.

Principal Investigator/Course Director:_____

Laboratory Safety Officer:_____
(Principal Investigator/Course Director is the Laboratory Safety Officer if one is not assigned)

Building:_____ Room(s):_____

Completed By:_____ Date:_____

Where are the designated areas in your laboratory to work with the acutely toxic chemicals (list all acutely toxic chemicals):

Reactive Liquids	Designated Area Location (e.g., Chemical Fume Hood)

The following Standard operating procedure (SOP) is intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this SOP contact the Principal Investigator of your laboratory, course director or the Office of Environmental Health and Safety (856-256-5105 or ehs@rowan.edu). Specific written procedures are the responsibility of the principal investigator/course director.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator/course director must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Reactive solids are chemicals that react vigorously with moisture and other substances. The most common reactive solids include sodium, potassium and lithium metals; acid anhydrides and acid chlorides.

Securing of gas cylinders

Not applicable

Decontamination procedures

- **Personnel:** Wash hands and arms with soap and water immediately after handling reactive solids.
- **Area:** Carefully clean work area after use.

Designated area

Not applicable

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, should be developed by each laboratory. The procedures should address as a minimum the following:

- **Who to contact:** (University police, Principal investigator of the laboratory including evening phone number, and Office of Environmental Health and Safety,
- The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.)

- The location and quantity of all reactive solids in the laboratory
- The method used to alert personnel in nearby areas of potential hazards
- Special first aid treatment required by the type of reactive solids material(s) handled in the laboratory

Eyewash

Where the eyes or body of any person may be exposed to reactive solids, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Fume hood

Many reactive solids will liberate hydrogen when they react with water. The use of a fume hood is recommended to prevent the buildup of combustible gases.

Glove (dry) box

Glove boxes may be used to handle reactive solids if inert or dry atmospheres are required.

Hazard assessment

Hazard assessment of work involving reactive solids should address proper use and handling techniques, fire safety (including the need for Class D fire extinguishers), storage, potential peroxide formation, water and air reactivity, and waste disposal issues.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling reactive solids. Additional protective clothing should be worn if the possibility of skin contact is likely.

The Principal Investigator/course director is responsible to the select the appropriate PPE.

The Office of Environmental Health and Safety is available to provide guidance.

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling reactive solids. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the Practice for Occupational and Educational Eye and Face Protection (ANSI/ISEA Z87.1-2010) and must be equipped with side shields. Safety glasses with side shields do not provide adequate

protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

The Principal Investigator/course director is responsible to the select the appropriate eye protection.

The Office of Environmental Health and Safety is available to provide guidance.

Gloves

Gloves should be worn when handling reactive solids. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals.

The Principal Investigator/Course Director is responsible to the select the appropriate chemical resistant glove when direct or prolonged contact with hazardous chemicals is anticipated.

The Office of Environmental Health and Safety is available to provide guidance.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of reactive solids which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

The Principal Investigator/Course Director is responsible to the select the appropriate shielding.

The Office of Environmental Health and Safety is available to provide guidance.

Safety shower

A safety or drench shower should be available in a nearby location where the reactive solids is used.

Signs and labels

Containers: All water reactive chemicals chemical must be clearly labeled with the correct chemical name, health hazard and CAS#. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. Chemical containers must be dated upon receipt as well as when opened.

Special storage

Reactive solids should be stored in a cool and dry location. Keep reactive solids segregated from all other chemicals in the laboratory. Minimize the quantities of reactive solids stored in the laboratory.

Date all containers upon receipt. Potassium will form peroxides and superoxides when stored under oil at room temperature. Examine storage containers frequently. Dispose of any container that exhibits salt build up on its exterior. Dispose of all reactive solids whenever they are no longer required for current research.

Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

Special ventilation

Special ventilation is required if these materials are used outside of a fume hood or glove box. If your research does not permit the handing of reactive solids in a fume hood or glove box you must contact the Office of Environmental Health and Safety to review the adequacy of all special ventilation.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any reactive solids chemical. Spill control materials for reactive solids are designed to be inert and will not react with the reagent.

In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of reactive solids. Turn off all ignition sources and vacate the laboratory immediately. Call for assistance.

- University Police 856-256-4911. This is a 24 hour service.
- Office of Environmental Health & Safety 856-256-5105

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Not applicable

Waste disposal

All materials contaminated with reactive solids should be disposed of as hazardous waste.

REACTIVE SOLIDS

Principal Investigator/Course Director:_____

Laboratory Safety Officer:_____
(Principal Investigator/Course Director is the Laboratory Safety Officer if one is not assigned)

Building:_____ Room(s):_____

Completed By:_____ Date:_____

Where are the designated areas in your laboratory to work with the reactive solids (list all acutely toxic chemicals):

Reactive Solids	Designated Area Location (e.g., Chemical Fume Hood)

The following Standard operating procedure (SOP) is intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any items listed in this SOP contact the Principal Investigator of your laboratory, course director or the Office of Environmental Health & Safety (856-256-5105 or ehs@rowan.edu). Specific written procedures are the responsibility of the principal investigator/course director.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator/course director must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health & Safety is available to provide guidance during the development of alternate procedures.

Reproductive hazards are substances which affect the reproductive capabilities including chromosomal damage (mutagens) and effects on the fetus (teratogens). A list of reproductive hazards is attached to this SOP.

Securing of gas cylinders

Not applicable

Decontamination procedures

- **Personnel:** Wash hands and arms with soap and water immediately after handling reproductive hazards.
- **Area:** Decontamination procedures vary depending on the material being handled. The toxicity of some materials can be neutralized with other reagents. All surfaces should be wiped with the appropriate cleaning agent following dispensing or handling. Waste materials generated should be treated as hazardous waste.
- **Equipment:** Decontaminate vacuum pumps or other contaminated equipment (glassware) before removing them from the designated area.

Designated area

The room sign for the laboratory must contain a *Designated Areas Within* identifier.

All locations within the laboratory where reproductive hazards are handled should be demarcated with designated area caution tape (available from EHRS, the cell center, or chemistry stockroom) and/or posted with designated area caution signs. This includes all fume hoods and bench tops where the reproductive hazards are handled.

Where feasible, reproductive hazards should be manipulated over plastic-backed disposable paper work surfaces. These disposable work surfaces minimize work area contamination and simplify clean up.

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, should be developed by each laboratory. The procedures should address as a minimum the following:

- **Who to contact:** (University police, Principal investigator of the laboratory including evening phone number, and Office of Environmental Health Safety)
- The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)
- The method used to alert personnel in nearby areas of potential hazards
- The location of all reproductive hazards stored in the laboratory
- Special first aid treatment required by the type of reproductive hazards handled in the laboratory

Fume hood

Manipulation of reproductive hazards should be carried out in a fume hood. If the use of a fume hood proves impractical refer to the section on special ventilation.
All areas where reproductive hazards are stored or manipulated must be labeled as a designated area.

Glove (dry) box

Certain reproductive hazards must be handled in a glove box rather than a fume hood. The Principal Investigator will determine if this is required. The Office of Environmental Health & Safety is available to provide guidance.

Hazard assessment

Hazard assessment should focus on proper handling techniques, education of laboratory workers concerning the health risks posed by reproductive hazards, and the demarcation of designated areas.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling reproductive hazards. Additional protective clothing should be worn if the possibility of skin contact is likely.

The Principal Investigator/Course Director is responsible to the select the appropriate PPE.

The Office of Environmental Health and Safety is available to provide guidance.

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling reproductive hazards. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the American Standard Practice for Occupational and Educational Eye and Face Protection (ANSI/ISEA Z87.1-2010) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for a splash hazard exists other eye protection and/or face protection must be worn.

The Principal Investigator/Course Director is responsible to the select the appropriate PPE.

The Office of Environmental Health and Safety is available to provide guidance.

Gloves

Gloves should be worn when handling reproductive hazards. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals.

The Principal Investigator/Course Director is responsible to the select the appropriate chemical resistant glove when direct or prolonged contact with hazardous chemicals is anticipated.

The Office of Environmental Health and Safety is available to provide guidance.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of reproductive hazards which pose this risk should be performed in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

The Principal Investigator/Course Director is responsible to the select the appropriate shielding.

The Office of Environmental Health and Safety is available to provide guidance.

Eyewash

Where the eyes or body of any person may be exposed to reproductive hazards, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the reproductive hazards are used.

Signs and labels

- **Doorways:** The room sign must contain a Designated Area Within Caution where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used.

- **Containers:** All water reactive chemicals chemical must be clearly labeled with the correct chemical name, health hazard and CAS#. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. Chemical containers must be dated upon receipt as well as when opened.

Special storage

Reproductive hazards must be stored in a designated area.

Special ventilation

Manipulation of reproductive hazards outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to reproductive hazards in the laboratory and are the preferred ventilation control device. When possible, handle reproductive hazards in a fume hood. If the use of a fume hood proves impractical attempt to work in a glove box or on an isolated area of the bench top.

If available, consider using a Biological Safety Cabinet. The biological safety cabinet is designed to remove particulates (the reproductive hazard) before the air is discharged into the environment. Reproductive hazards that are volatile must not be used in a biological safety cabinet unless the cabinet is vented to the outdoors.

If your research does not permit the handing of reproductive hazards in a fume hood, biological safety cabinet, or glove box, you must contact the Office of Environmental Health and Safety.

All areas where reproductive hazards are stored or manipulated must be labeled as a designated area.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any reproductive hazard.

In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a spill of reproductive hazards. Vacate the laboratory immediately and call for assistance.

- University Police 856-256-4911. This is a 24 hour service.
- Office of Environmental Health & Safety 856-256-5105 or ehs@rowan.edu

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Evacuated glassware can implode and eject flying glass, and splattered chemicals. Vacuum work involving reproductive hazards must be conducted in a fume hood, glove box or isolated in an acceptable manner.

Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood.

Waste disposal

All materials contaminated with reproductive hazards should be disposed of as a hazardous waste. Wherever possible, attempt to design research in a manner that reduces the quantity of waste generated. EHS can assist you in minimizing waste generation.

Principal Investigator/Course Director:_____

Laboratory Safety Officer:_____
(Principal Investigator/Course Director is the Laboratory Safety Officer is one is not assigned)

Building:_____ Room(s):_____

Completed By:_____ Date:_____

Where are the designated areas in your laboratory to work with the reproductive hazards (list all reproductive hazards):

REPRODUCTIVE HAZARDS	Designated Area Location (e.g., Chemical Fume Hood)

LIST OF REPRODUCTIVE HAZARDS
The list is provided as a guide and is not all inclusive. Review Safety Data Sheets

Name	CAS#	Name	CAS#
Acetaldehyde	75-07-0	Hydrazine(s)	302-01-2
Arsenic	7440-38-2	Hexafluoroacetone	684-16-2
Aniline	62-53-3	Halothane	151-67-7
Aflatoxins		Karathane	131-72-6
Benzene	71-43-2	Lead (inorganic compounds)	7439-92-1
Benzo(a)pyrene	50-32-8	2-Methoxyethanol	109-86-4
Carbon disulfide	75-15-0	2-Methoxyethyl acetate	110-49-6
Chloroform	67-66-3	Methyl chloride	74-87-3
Chloroprene	126-99-8	N-Methyl-2-pyrrolidone	872-50-4
Dimethyl formamide	68-12-2	Propylene glycol monomethyl ether	107-98-2
Di-sec-octyl-phthalate	117-81-7	Propylene glycol monomethyl ether acetate	108-65-6

Name	CAS#	Name	CAS#
Dinitrooctyl phenol	63149-81-5	Propylene oxide	75-56-9
Dithane	111-54-6	Trichloroethylene	79-01-6
2-Ethoxy ethanol	110-80-5	RH-7592	
2-Ethoxyethyl acetate	111-15-9v	Systhane/RH-3866	88671-89-0
Ethylene thiourea	96-45-7	TOK (herbicide)	1836-75-5
2-Ethyhexanol	104-76-7	Toluene	108-88-3
Glycol ethers		Vinyl chloride	75-01-4

The following Standard operating procedure (SOP) is intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this SOP contact the Principal Investigator of your laboratory, Course Director or the Office of Environmental Health and Safety (856-256-5105 or ehs@rowan.edu). Specific written procedures are the responsibility of the principal investigator/Course Director.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator/course director must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Water-Reactive chemicals are chemicals that react vigorously with moisture. The most common water-reactive chemicals include sodium, potassium, lithium metals and aluminum alkyls.

Securing of gas cylinders

Not applicable

Decontamination procedures

- **Personnel:** Wash hands and arms with soap and water immediately after handling Water-Reactive Chemicals.
- **Area:** Carefully clean work area after use.

Designated area

Not applicable

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, should be developed by each laboratory. The procedures should address as a minimum the following:

- **Who to contact:** (University police, Principal investigator of the laboratory including evening phone number and Office of Environmental Health Safety)
- The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.)

- The location of all Water-Reactive Chemicals in the laboratory
- The method used to alert personnel in nearby areas of potential hazards
- Special first aid treatment required by the type of Water-Reactive chemicals handled in the laboratory

Fume hood

Many water-reactive chemicals will liberate hydrogen when they react with water. The use of a fume hood is recommended to prevent the buildup of combustible gases.

Glove (dry) box

A glove box may be used to handle water-reactive chemicals when a dry atmosphere is required.

Hazard assessment

Hazard assessment of work involving water-reactive chemicals should address proper use and handling techniques, fire safety (including the need for Class D fire extinguishers), storage, water reactivity, and waste disposal issues.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling water-reactive chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

The Principal Investigator/Course Director is responsible to the select the appropriate chemical resistant glove when direct or prolonged contact with hazardous chemicals is anticipated.

The Office of Environmental Health and Safety is available to provide guidance.

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling water-reactive chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the American Standard Practice for Occupational and Educational Eye and Face Protection (ANSI/ISEA Z87.1-2010) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

The Principal Investigator/Course Director is responsible to the select the appropriate eye protection.

The Office of Environmental Health and Safety is available to provide guidance.

Gloves

Gloves should be worn when handling water-reactive chemicals. Disposable nitrile gloves provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals.

The Principal Investigator is responsible to select the appropriate chemical resistant glove when direct or prolonged contact with hazardous chemicals is anticipated.

The Office of Environmental Health and Safety is available to provide guidance.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of water-reactive chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

The Principal Investigator is responsible to the select the appropriate shielding exposure is anticipated.

The Office of Environmental Health and Safety is available to provide guidance.

Eyewash

Where the eyes or body of any person may be exposed to water-reactive chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the water-reactive chemicals is used.

Signs and labels

Containers: All water reactive chemicals chemical must be clearly labeled with the correct chemical name, health hazard and CAS#. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. Chemical containers must be dated upon receipt as well as when opened.

Special storage

Water-reactive chemicals should be stored in a cool and dry location. Keep water sensitive chemicals segregated from all other chemicals in the laboratory. Minimize the quantities of water sensitive chemicals stored in the laboratory.

Date all containers upon receipt. Potassium will form peroxides and super oxides when stored under oil at room temperature. Examine storage containers frequently. Dispose of any container that exhibits salt build up on its exterior. Dispose of all water-reactive chemicals whenever they are no longer required for current research.

Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

Special ventilation

Special ventilation is required if these materials are used outside of a fume hood. If your research does not permit the handing of water-reactive chemicals in a fume hood you must contact the Office of Environmental Health and Safety to review the adequacy of all special ventilation.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any water-reactive chemicals. Spill control materials for water-reactive chemicals are designed to be inert and will not react with the reagent. Do not put water on the spill.

In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of water-reactive chemicals. Turn off all ignition sources and vacate the laboratory immediately. Call for assistance.

- University Police 856-256-4911. This is a 24 hour service.
- Office of Environmental Health & Safety 856-256-5105 or ehs@rowan.edu

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Not applicable

Waste disposal

All materials contaminated with water-reactive chemicals should be disposed of as hazardous waste.

Principal Investigator/Course Director:_____

Laboratory Safety Officer:_____
(Principal Investigator/Course Director is the Laboratory Safety Officer if one is not assigned)

Building:_____ Room(s):_____

Completed By:_____ Date:_____

Where are the designated areas in your laboratory to work with the water reactive chemicals (list all acutely toxic chemicals):

Water Reactive Chemicals	Designated Area Location (e.g., Chemical Fume Hood)

The following Standard Operating Procedure (SOP) is intended to provide you with general guidance on how to safely work with a specific class of chemical or hazard. This SOP is generic in nature. It addresses the use and handling of substances by hazard class only. In some instances multiple SOPs may be applicable for a specific chemical (i.e., both the SOPs for flammable liquids and carcinogens would apply to benzene). If you have questions concerning the applicability of any item listed in this SOP contact the Principal Investigator of your laboratory, course Director or the Office of Environmental Health and Safety (856-256-5105 or ehs@rowan.edu). Specific written procedures are the responsibility of the principal investigator/course director.

If compliance with all the requirements of this standard operating procedure is not possible, the principal investigator/course director must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Hazard Definition

Peroxide-forming chemicals are a class of materials that have the ability to form shock-sensitive and explosive peroxide crystals. When triggered by friction or shock the peroxides will explode. Peroxide forming chemicals include solids, liquids and gases. These chemicals may also be flammable or reactive so other SOPs will likely apply to their use in the laboratory. The Safety Data Sheet and label for peroxide-forming chemicals may or may not include the following hazard statement: 2.3 Hazards not otherwise classified (HNOC) or not covered by GHS: May form explosive peroxides.

Securing of gas cylinders

Not applicable

Designated area

Not applicable

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, should be developed by each laboratory. The procedures should address as a minimum the following:

- **Who to contact:** (University police, Principal investigator of the laboratory including evening phone number and Office of Environmental Health Safety)
- The location of all safety equipment (showers, spill equipment, eye wash, fire extinguishers, etc.)

- The location of all Peroxide forming chemicals in the laboratory
- The method used to alert personnel in nearby areas of potential hazards
- Special first aid treatment required by the type of Peroxide forming chemicals handled in the laboratory

Fume hood

The use of a fume hood is recommended.

Hazard assessment

Hazard assessment of work involving peroxide forming chemicals should address proper use and handling techniques, fire safety (including the need for Class D fire extinguishers), storage, water reactivity, and waste disposal issues.

Protective apparel

Lab coats, closed toed shoes and long sleeved clothing should be worn when handling water-reactive chemicals. Additional protective clothing should be worn if the possibility of skin contact is likely.

The Principal Investigator/course director is responsible to the select the appropriate PPE.

The Office of Environmental Health and Safety is available to provide guidance.

Eye protection

Eye protection in the form of safety glasses must be worn at all times when handling water-reactive chemicals. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of the American Standard Practice for Occupational and Educational Eye and Face Protection (ANSI Z.87. 1 1989) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for splash hazard exists other eye protection and/or face protection must be worn.

The Principal Investigator/Course Director is responsible to the select the appropriate eye protection.

The Office of Environmental Health and Safety is available to provide guidance.

Gloves

Gloves should be worn when handling peroxide forming chemicals.

The Principal Investigator/Course Director is responsible to the select the appropriate chemical resistant glove when direct or prolonged contact with hazardous chemicals is anticipated.

The Office of Environmental Health and Safety is available to provide guidance.

Safety shielding

Safety shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of peroxide forming chemicals which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are acceptable.

The Principal Investigator/Course Director is responsible to the select the appropriate shielding.

The Office of Environmental Health and Safety is available to provide guidance.

Eyewash

Where the eyes or body of any person may be exposed to peroxide forming chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the peroxide forming chemical is used.

Signs and labels

Containers: All water reactive chemicals chemical must be clearly labeled with the correct chemical name, health hazard and CAS#. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. Chemical containers must be dated upon receipt as well as when opened.

Storage

Peroxides form after exposure to air. The rate of peroxide formation is dependent on the specific chemical, the amount of air exposure and whether the chemical contains and inhibitor to retard peroxide formation. Therefore, it is imperative that potential peroxide-forming chemicals be entered into the lab's chemical inventory and assigned an expiration date based the storage limitations for the chemical's class (see class descriptions below). Peroxide-forming chemicals should be stored away from light and heat with tightly secured caps and labeled with dates of receipt and opening.

Date all containers upon receipt. Potassium will form peroxides and super oxides when stored under oil at room temperature. Examine storage containers frequently. Dispose of any container that exhibits salt build up on its exterior. Dispose of all peroxide forming chemicals whenever they are no longer required for current research.

Never return excess chemicals to the original container. Small amounts of impurities may be introduced into the container which may cause a fire or explosion.

Special ventilation

Special ventilation is required if these materials are used outside of a fume hood. If your research does not permit the handing of peroxide forming chemicals in a fume hood you must contact the Office of Environmental Health and Safety to review the adequacy of all special ventilation.

Spill response

Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the material safety data sheet. This should occur prior to the use of any water-reactive chemicals. Spill control materials for peroxide forming chemicals are designed to be inert and will not react with the reagent. Do not put water on the spill.

In the event of a spill alert personnel in the area that a spill has occurred. Do not attempt to handle a large spill of water-reactive chemicals. Turn off all ignition sources and vacate the laboratory immediately. Call for assistance.

- University Police 856-256-4911. This is a 24 hour service.
- Office of Environmental Health & Safety 856-256-5105 or ehs@rowan.edu

Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Vacuum protection

Not applicable

Waste disposal

All materials contaminated with peroxide forming chemicals should be disposed of as hazardous waste.

LABORATORY SPECIFIC STANDARD OPERATING PROCEDURE
PEROXIDE FORMING CHEMICALS

Principal Investigator/Course Director:_____

Laboratory Safety Officer:_____
(Principal Investigator/Course Director is the Laboratory Safety Officer if one is not assigned)

Building:_____ Room(s):_____

Completed By:_____ Date:_____

Where are the designated areas in your laboratory to work with the peroxide forming chemicals (list all acutely toxic chemicals):

Peroxide Forming Chemicals	Designated Area Location (e.g., Chemical Fume Hood)

Classes of Peroxide-Forming Chemicals

Peroxide formers fall into three classes. Class I peroxide forming chemicals can form explosive levels of peroxides while sitting on the shelf. These chemicals should be tested

before use or disposed of through the chemical waste system three months after opening or three months prior to the expiration date on the container if unopened. Contact EHS if there crystals are present or if the solvent is discolored.

CHEMICAL	**SYNONYMS**
Isopropyl Ether	Diisopropyl Ether, Diisopropyl Oxide
Diethyl Ketene	2-Ethyl-1-butene-1-one
Divinyl Ether	Vinyl Ether, Divinyl Oxide
Potassium Metal	Potassium
Potassium Amide	
Sodium Amide	Sodamide
Sodium Ethoxyacetylide	
Vinylidene Chloride	1,1-Dichloroethylene, 1,1-Dichloroethane

Class II peroxide formers are only a hazard if the peroxides are concentrated, which may happen upon evaporation or distillation of the solvent. These materials should be disposed of 1 year after opening or three months prior to the expiration date on the container if unopened.

Expire 1 year after opening:

Acetal	2-Cyclohexen-1-ol
Acetaldehyde	Cyclopentene
Benzyl alcohol	Decahydronaphthalene (decalin)
2-Butanol Dioxanes	Diacetylene (butadiyne)
Chlorofluoroethylene	Dicyclopentadiene
Cumene (isopropylbenzene)	Diethylene glycol dimethyl-ether (diglyme)
Cyclohexene	Methyl-isobutyl ketone
Ether, Diethyl ether, Ethoxyethane	4-Methyl-2-pentanol
Ethylene glycol ether acetates (cellosolves)	2-Pentanol
Furan	4-Penten-1-ol
4-Heptanol	1-Phenylethanol
2-Hexanol	2-Phenylethanol
Methyl Acetylene	Tetrahydrofuran
3-Methyl-1-butanol	Tetrahydronphthalene
Vinyl Ethers	p-Dioxane
Methyl-isobutyl ketone	Cyclopentene
Furan	Methyl Cyclopentene

Class III peroxide formers may auto-polymerize as a result of peroxide formation. These materials should be disposed of 1 year after opening or three months prior to the expiration date on the container if unopened.

Expire 1 year after opening:

Butadiene	Vinyldiene Chloride
Chlorobutadiene	Vinyl Acetylene
Chloroprene	Vinyl Chloride
Vinyl Acetate	Vinyl Pyridine
Chlorotrifluoroethylene	Tetrafluoroethylene
Styrene	

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If compliance with all the requirements of this standard operating procedure is not possible, the Principal Investigator/Course Director must develop a written procedure that will be used in its place. This alternate procedure must provide the same level of protection as the SOP it replaces. The Office of Environmental Health and Safety is available to provide guidance during the development of alternate procedures.

Corrosive chemicals are substances that cause visible destruction or permanent changes in human skin tissue at the site of contact, or are highly corrosive to steel. Corrosive chemicals can be liquids, solids, or gases and can affect the eyes, skin, and respiratory tract. The major classes of corrosives include strong acids, bases, and dehydrating agents. Liquid **corrosive** chemicals are those with a pH of 4.0 or lower or a pH of 9 or higher. Solid chemicals are considered corrosive when in solution; they fall in the above pH range. A **highly corrosive** chemical has a pH of 2 or lower or a pH of 12.5 or higher. **Injurious** chemicals cause tissue destruction at the site of contact.

Some examples of corrosive materials:

Strong Acids: hydrochloric, sulfuric, phosphoric
Strong Bases: hydroxides of sodium, potassium, ammonia
Strong Dehydrating Corrosives: sulfuric, phosphophrous pentoxide, calcium oxide
Strong Oxidizing Corrosives: concentrated hydrogen peroxide, sodium hypochlorite
Corrosive Gases: chlorine, ammonia
Corrosive Solids: phosphorous, phenol

Storage: Corrosive Chemical Storage Cabinets

- Chemicals should be segregated according to the Chemical Storage and Transportation section of the Chemical Hygiene Plan
- Cabinets: Specially designed corrosion resistant cabinets should be used for the storage of large quantities of corrosive materials.
- If no corrosion-resistant cabinet is available, store corrosives on plastic trays.
- Do not store corrosive liquids above eye level.

Engineering Controls (ventilation, shielding, vacuum protection)

- Safety Shielding: Shielding is required any time there is a risk of explosion, splash hazard or a highly exothermic reaction. All manipulations of corrosives which pose this risk should occur in a fume hood with the sash in the lowest feasible position. Portable shields, which provide protection to all laboratory occupants, are also acceptable.

  The Principal Investigator/Course Director is responsible to the select the appropriate shielding.

  The Office of Environmental Health and Safety is available to provide guidance.

- Special Ventilation: Corrosive materials must be handled in a chemical fume hood if production of corrosive vapor is anticipated. Manipulation of corrosives outside of a fume hood may require special ventilation controls in order to minimize exposure to the material. Fume hoods provide the best protection against exposure to corrosives in the laboratory and are the preferred ventilation control device. Always attempt to handle quantities of corrosives greater than 500 mL in a fume hood. If your research does not permit the handing of large quantities of corrosives in your fume hood, contact the EHS to review the adequacy of all special ventilation.

- Vacuum Protection: Evacuated glassware can implode and eject flying glass, and chemicals. Vacuum work involving corrosives must be conducted in a fume hood, glove box or isolated in an acceptable manner. Mechanical vacuum pumps must be protected using cold traps and, where appropriate, filtered to prevent particulate release. The exhaust for the pumps must be vented into an exhaust hood. Vacuum pumps should be rated for use with corrosives.

Personal Protective Equipment

- Splash proof goggles in addition to standard laboratory personal protective equipment (PPE) consisting of a 100% cotton lab coat, closed toe shoes and nitrile gloves must be worn when there is a significant risk of splash. Pouring very large volumes or handling particularly corrosive materials may require additional PPE consisting of thicker gloves and an apron.

  The Principal Investigator/course director is responsible to the select the appropriate chemical resistant glove when direct or prolonged contact with hazardous chemicals is anticipated.

  The Office of Environmental Health and Safety is available to provide guidance.

- Eye protection in the form of safety glasses must be worn at all times when handling corrosives. Ordinary (street) prescription glasses do not provide adequate protection. (Contrary to popular opinion these glasses cannot pass the rigorous test for industrial safety glasses.) Adequate safety glasses must meet the requirements of

the Practice for Occupational and Educational Eye and Face Protection (ANSI/ISEA Z87.1-2010) and must be equipped with side shields. Safety glasses with side shields do not provide adequate protection from splashes; therefore, when the potential for a splash hazard exists other eye protection and/or face protection must be worn. In addition to safety glasses, a face shield should be worn when splash or spray is foreseeable.

The Principal Investigator/course director is responsible to the select the appropriate eyewear.

The Office of Environmental Health and Safety is available to provide guidance.

- Gloves must be worn when handling corrosives. Disposable nitrile gloves (4 mil minimum thickness) provide adequate protection against accidental hand contact with small quantities of most laboratory chemicals. Lab workers should contact EHRS for advice on chemical resistant glove selection when direct or prolonged contact with hazardous chemicals is anticipated.

  The Principal Investigator/course director is responsible to the select the appropriate chemical resistant glove when direct or prolonged contact with hazardous chemicals is anticipated.

  The Office of Environmental Health and Safety is available to provide guidance.

- Some examples of when specialty gloves may be necessary are: Handling of hydrofluoric acid, when immersion in corrosive liquids is anticipated, when large volumes of corrosive liquids are being transferred or dispensed.

- At a minimum, 100% cotton lab coats, closed toed shoes and long-sleeved clothing must be worn when handling corrosives. Additional protective clothing, such as a chemical-resistant apron, should be worn if the possibility of skin contact is likely.

- Protect all skin surfaces from contact with corrosive or irritating gases and vapors.

Eyewash

Where the eyes or body of any person may be exposed to oxidizing chemicals, suitable facilities for quick drenching or flushing of the eyes and body shall be provided within the work area for immediate emergency use. Bottle type eyewash stations are not acceptable.

Safety shower

A safety or drench shower should be available in a nearby location where the oxidizing chemicals are used.

Safety Data Sheet

Consult the Safety Data Sheet (SDS) for any new corrosive chemicals you introduce to your lab. Fully assess the potential hazards and consider what safety equipment will be needed before you begin your work.

Signs and labels

- **Doorways:** The room sign must contain a Designated Area Within identifier where carcinogens, reproductive hazards, and/or acutely toxic chemicals are stored or used.
- **Containers:** All acutely toxic chemicals must be clearly labeled with the correct chemical name and CAS #. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable. Chemical containers must be dated upon receipt as well as when opened.

Handling

Handling process for liquids should be designed to minimize the potential for splash, splatter, or other likely scenarios for accidental contact.

Do not pour water into acid. Slowly add acid to water with stirring and cooling if heat generation can be anticipated.

Reactions involving acids and bases are often very exothermic

- Use only heat resistant labware
- Allow for extra volume in your mixing or reaction vessel to account for expansion and/or foaming
- It may be necessary to pre-cool solutions and cool while mixing or reacting
- Corrosive Gases
    - Corrosive compressed gases can burn and destroy body tissue (especially the eyes or respiratory contact) on contact. The magnitude of the effect is related to the solubility of the material in the body fluids. Highly soluble gases such as ammonia or hydrogen chloride can cause severe nose and throat irritation, while substances of lower solubility such as nitrogen dioxide, phosgene, or sulfur dioxide can penetrate deep into the lungs. Corrosive gases also can corrode metals. Warming properties such as odor or eye, nose or respiratory tract irritation may be inadequate with some substances. Do not rely upon these symptoms as warning of overexposure.
    - All procedures detailed in the Standard Operating Procedures for Compressed Gases should be followed for work with corrosive gases.

    - Perform manipulations of materials that pose an inhalation hazard in a chemical fume hood to control exposure.
    - To prevent environmental pollution and damage to equipment it may be necessary to trap and or scrub exhaust from processes which utilize corrosive gases even when working in the fume hood.
    - When corrosive gases are to be discharged into a liquid, a trap, check valve, or vacuum break device must be employed to prevent dangerous reverse flow.
    - Regulators and valves must be closed when the cylinder is not in use and flushed with dry air or nitrogen after use.
- Labeling
    - All corrosives must be clearly labeled with the correct chemical name. Handwritten labels are acceptable; chemical formulas and structural formulas are not acceptable.
    - The label on any containers of corrosives should say "Flammable" and include any other hazard information, such as "Flammable" or "Toxic", as applicable.
- Heating/Open flame
    - Do not store corrosives in chemical fume hoods or allow containers of corrosives in proximity to heating mantles, hot plates, or torches.
- Transferring/Dispensing
    - Weighing, transferring, and dispensing of corrosive solids must be performed carefully to avoid aspiration and ingestion of airborne powders and solids.
    - The materials of construction for lab apparatus and vessels that will come in contact with corrosive chemicals must be evaluated for compatibility with the chemical in use.
    - Transport corrosives in secondary containment, preferably a polyethylene or other non-reactive bottle carrier and/or a sturdy cart designed for chemical transport.
    - When combining acid and water, always add ACID to WATER

Emergency procedure

Emergency procedures which address response actions to fires, explosions, spills, injury to staff, should be developed by each laboratory. The procedures should address as a minimum the following:

- **Who to contact:** (Public Safety, Principal investigator/course director of the laboratory including evening phone number and Office of Environmental Health and Safety)
- The location of all safety equipment (showers, eye wash, fire extinguishers, etc.)
- The method used to alert personnel in nearby areas of potential hazards
- Special first aid treatment required by the type of acutely toxic material(s) handled in the laboratory

Emergency Procedures – Spill Clean Up

- Spill Clean Up

- Anticipate spills by having the appropriate clean up equipment on hand. The appropriate clean up supplies can be determined by consulting the Safety Data Sheet. This should occur prior to the use of any corrosives.
- Corrosive spill controls neutralize the hazardous nature of the spilled material. Acids and bases require different types of spill control materials.
  - Specific acid and base neutralizing spill kits are available from one of Rowan University's preferred vendor's.
- Sodium carbonate (soda ash) can also be used to neutralize spills of acidic liquids prior to clean-up.
- In the event of a spill all personnel in the area should be alerted. Turn off all sources of ignition.
- Waste disposal
  - Corrosives are hazardous wastes. All waste generated during a spill clean up should be disposed of through the University's hazardous waste vendor.

Emergency Procedures – Decontamination

- Decontamination
  - **Personnel:** Immediately flush contaminated area with copious amounts of water after contact with corrosive materials. Remove any jewelry to facilitate removal of chemicals. If a delayed response is noted report immediately for medical attention. Be prepared to detail what chemicals were involved. If there is any doubt about the severity of the injury, seek immediate medical attention.
  - **Area:** Decontamination procedures vary depending on the material being handled.

Contact University's Emergency Response number 856-256-4911 in the event of a large spill. Remain on the scene, but at a safe distance, to receive and direct safety personnel when they arrive.

Fire

- RESCUE anyone in the same room as you if they need assistance.
- Pull the fire alarm to ALERT everyone of the emergency
- CONFINE the emergency by closing doors behind you.
- EVACUATE the building by using the stairs. Never use the elevators.
- Make yourself available to give emergency responders information as needed

Principal Investigator/Course Director:_____

Laboratory Safety Officer:_____
(Principal Investigator/Course Director is the Laboratory Safety Officer if one is not assigned)

Building: Room(s):

Completed By: Date:

Where are the designated areas in your laboratory to work with the corrosive chemicals (list all corrosive chemicals):

Corrosive Chemicals	Designated Area Location (e.g., Chemical Fume Hood)