## TABLE OF CONTENTS

**PREFACE**

- P.1 PURPOSE
- P.2 APPLICABILITY
- P.3 AUTHORITY
- P.4 APPLICABLE DOCUMENTS AND FORMS
- P.5 MEASUREMENT/VERIFICATION
- P.6 CANCELLATION

**1.0 INTRODUCTION**

- 1.1 GENERAL
- 1.2 RESPONSIBILITY

**2.0 SAFE LABORATORY PRACTICES**

- 2.1 DRESS CODE
- 2.2 EATING / DRINKING
- 2.3 HYGIENE / HOUSEKEEPING
- 2.4 USE OF ELECTRONIC DEVICES
- 2.5 EMERGENCIES
- 2.6 EMPLOYEE EXPOSURE / PROTECTION
- 2.7 PERSONAL PROTECTIVE EQUIPMENT
- 2.8 TRAINING
- 2.9 MEDICAL CONSULTATION/EXAMINATION
- 2.10 SAFETY DATA SHEET (SDS) PROGRAM
- 2.11 CONTAINER WARNING LABELS AND HAZARD INFORMATION
- 2.12 HAZARDOUS WASTE HANDLING AND DISPOSAL
3.0 PROCEDURES FOR WORKING WITH SPECIFIC CHEMICAL CLASSES ............... 20
  3.1 HANDLING OF HAZARDOUS MATERIALS .................................................. 20
  3.2 ACIDS ........................................................................................................ 21
  3.3 BASES/CAUSTICS ..................................................................................... 22
  3.4 OXIDIZERS .................................................................................................. 22

4.0 PROCEDURES FOR WORKING WITH TOXIC SUBSTANCES ................. 24
  4.1 HANDLING OF TOXIC SUBSTANCES ...................................................... 24
  4.2 REPRODUCTIVE HAZARDS .................................................................... 25
  4.3 SELECT CARCINOGENS ........................................................................... 26
  4.4 SENSITIZERS ............................................................................................. 26
  4.5 HIGHLY TOXIC CHEMICALS ..................................................................... 27

5.0 PROCEDURES FOR WORKING WITH FLAMMABLES / EXPLOSIVES AND OTHER HAZARDS ................................................................. 28
  5.1 FLAMMABLES ............................................................................................ 28
  5.2 PEROXIDES ............................................................................................... 30
  5.3 PYROPHORICS .......................................................................................... 32
  5.4 COMPRESSED GASES ............................................................................. 31
  5.5 CRYOGENS ............................................................................................... 32
  5.6 WATER REACTIVE CHEMICALS ................................................................. 34

6.0 PROCEDURES, ACTIVITIES, OPERATIONS REQUIRING PRIOR APPROVAL BEFORE IMPLEMENTATION ............................................................................. 35
  6.1 GENERAL .................................................................................................. 35
  6.2 DESIGNATED WORK AREAS ..................................................................... 35

7.0 LABORATORY HOOD PROGRAM ............................................................... 37
  7.1 INTRODUCTION .......................................................................................... 37
  7.2 VENTILATION SPECIFICATIONS ............................................................... 37
  7.3 LABORATORY HOOD GUIDELINES ........................................................... 37

APPENDIX A DEFINITIONS ................................................................................. 41
APPENDIX B ACRONYMS .................................................................................... 41
PREFACE

P.1 PURPOSE

This Langley Procedural Requirement (LPR) has been developed in accordance with OSHA 29 CFR 1910.1450, “Occupational Exposure to Hazardous Chemicals in Laboratories.” It outlines specific workplace practices and procedures to ensure that employees are protected from health hazards associated with the chemicals with which they work.

P.2 APPLICABILITY

a. These requirements apply to all permanently badged persons performing work at LaRC, including civil servants, on-site contractors, research associates, and others.

b. Temporary badged contractors are required to meet all appropriate state and OSHA requirements.

c. Noncompliance with the requirements of this LPR may result in appropriate disciplinary action against civil service employees or sanctions against contractors in accordance with the terms of their contracts.

P.3 AUTHORITY


b. 49 CFR 171, “General Information, Regulations, and Definitions”


P.4 APPLICABLE DOCUMENTS AND FORMS

a. Langley Procedural Requirement (LPR) 1710.4, “Personnel Protective Clothing and Equipment”

b. LPR 1710.5, “Ionizing Radiation”

c. LPR 1710.7 – “Handling and Use of Explosives”
d. LPR 1710.8, “Non-Ionizing Radiation”


f. LPR 1740.6, “Personnel Safety Certification”

g. LPR 8500.1, “LaRC Environmental and Energy Program Manual”

h. Langley Form (LF) 44, “Hazardous Material--Procurement, Inventory, and Storage Record”

i. LF 52, “Shipping/Transfer Document”

j. LF 62, “Chemical Worker's Certification Card”

k. LF 66, “Worker Appointment and Certification Form”

l. LF 118, “Safety Permit Request - Hazardous Material”

m. LF 131, “Receipt and Inspection Report (Non-stocked Items)”

n. LF 163, “Waste Material Data Sheet”

o. LF 175, “Material Safety Data Sheet Review Request”

p. LF 381, “Laboratory Specific Chemical Hygiene Plan (CHP) Information”

q. LF 498, “Safety Permit”

P.5 MEASUREMENT/VERIFICATION

a. Annual Industrial Hygiene and Safety audits conducted by the Safety and Facility Branch.

b. Annual review of laboratory specific chemical hygiene plans by laboratory personnel.

P.6 CANCELLATION

LPR 1710.13, dated October 20, 2011
LPR 1710.13, dated April 25, 2013

/s/ Clayton Turner March 30, 2018
Deputy Director Date
DISTRIBUTION
Approved for public release via the Langley Management System; distribution is unlimited.
1.0 INTRODUCTION

1.1 GENERAL

1.1.1 Information in this Langley Procedural Requirement (LPR) shall be supplemented with a Laboratory Specific Chemical Hygiene Plan (CHP) developed using Langley Form (LF) 381.

1.1.2 Each organization shall maintain a CHP for each laboratory.

1.1.3 The CHP shall be posted in a conspicuous location at each individual lab.

1.1.4 The CHP shall be reviewed annually by all personnel that work in the laboratory.

1.1.5 The CHP is not a substitute for existing safety handbooks, regulations, or operating procedures, but rather a summary or supplement, relevant to LaRC laboratories.

1.1.6 It is important for laboratory personnel to read LPRs 1710.12 and 1710.13, Laboratory Specific CHP for their work area, and other required safety-related documents.

1.1.7 It is important for laboratory personnel to understand the contents of OSHA regulatory Standard 29 CFR 1910.1450 “Occupational Exposure to Hazardous Chemicals in Laboratories” and its appendices.

1.1.8 No one is expected to retain all of this material; however, everyone is expected to know:

a. Who to contact concerning safety related matters.

b. Where to find safety-related documentation and reference materials.

1.2 RESPONSIBILITY

1.2.1 LaRC Safety Manager - Head, Safety and Facility Assurance Branch (SFAB) shall:

a. Be responsible for the development of safety programs as outlined in LaRC directives and procedural requirements, including overall responsibility for CHP.

b. Monitor the procurement, storage, use, and disposal of chemicals used.
c. Approve all safety permits and chemical worker certifications.

d. Provide regular, formal chemical hygiene, and housekeeping inspections, including routine inspections of emergency equipment.

e. Assist project directors in the development of precautions and identification of applicable facilities for the work.

f. Conduct periodic ventilation measurements to assure proper functioning of fume hoods and other local exhaust ventilation equipment.

1.2.2 Chemical Hygiene Officer (CHO)/Facility Safety Head (FSH)

1.2.2.1 For laboratories operating under a CHP, the FSH shall be the designated CHO.

1.2.2.2 The CHO/FSH shall:

a. Monitor the procurement, storage, use, and disposal of chemicals within their facilities.

b. Provide technical guidance in the development and implementation of the provisions of the CHP and applicable LF 498s.

c. Ensure that appropriate audits are conducted.

d. Know the current legal requirements concerning regulated substances.

e. Coordinate necessary training in accordance with this LPR.

f. Establish and review normal and emergency operating procedures.

g. Consult with the SFAB Industrial Hygiene (IH) staff concerning chemical control measures, including ventilation and personal protective equipment.

h. Annually review and sign the CHP.

1.2.3 Laboratory Supervisors shall:

a. Ensure that workers know and follow the chemical hygiene rules, that personal protective equipment (PPE) is available and in working order, and that appropriate training has been provided.

b. Plan each operation in accordance with the facility’s chemical hygiene procedures.

c. Know the current legal requirements concerning regulated substances.
1.2.4 All laboratory personnel shall:

a. Be required to read and understand this LPR, the CHP, and Safety Permits (that may be issued) for all laboratories in which they work.

b. Conduct each operation in accordance with the facility’s chemical hygiene procedures.

c. Be informed of the hazards associated with each chemical being used, by reviewing Safety Data Sheet (SDS) information prior to use.

d. Understand hazard control procedures, including decontamination procedures of work surfaces and removal of contaminated waste containing carcinogens, reproductive toxins, and acutely toxic chemicals.

e. Know and use required PPE for each operation.

f. Practice good personal hygiene habits.
2.0 SAFE LABORATORY PRACTICES

2.1 DRESS CODE

2.1.1 Clothing worn by laboratory personnel shall protect the body from chemical exposure or burns.

2.1.2 Shorts, cut-off sleeves, fishnet shirts, and tank tops shall not be permitted at any time.

2.1.3 No employees shall be permitted to work shirtless or barefoot.

2.1.4 Open-toe or high-heel shoes, sandals, thongs, or flip-flops shall not be worn in laboratories.

2.1.5 Laboratory coats shall be worn over street clothing to prevent the transfer of hazardous materials from the work to home environment.

2.2 EATING / DRINKING

2.2.1 Consumption of food and/or beverages shall not be permitted in the laboratory and process areas.

2.2.2 Glassware or utensils that have been used for laboratory operations shall never be used for food or beverages.

2.2.3 Laboratory refrigerators and ice machines shall not be used for food storage.

2.2.4 The ice from laboratory ice machines shall not be used in beverages.

2.2.5 Labels shall be posted on all laboratory refrigerators, microwave ovens, and ice machines indicating that they are unsafe for food use.

2.3 HYGIENE / HOUSEKEEPING

2.3.1 Mouth suction shall not be used to pipette chemicals or to start a siphon.

2.3.1.1 A pipette bulb or aspirator shall be used to provide vacuum.

2.3.2 Hands and exposed skin shall always be washed with soap and water before employees leave the laboratory area and before and after glove use.
2.3.2.1 Solvents shall not be used for washing skin.

2.3.2.2 The application of cosmetics shall not be allowed in a laboratory or process areas of a facility.

2.3.2.3 Protective gloves and clothing shall be used to keep chemicals off skin.

2.3.3 The laboratory area shall be kept clean and free from obstructions.

2.3.4 Disposal of “Sharps”

2.3.4.1 Broken glass shall be carefully placed in the cardboard disposal boxes located in each laboratory and/or process area.

2.3.4.2 Used razor blades shall be disposed of in special containers located in each laboratory and not thrown in the trash.

2.3.4.3 Contact the FSH or Facility Coordinator for special containers for needle disposal.

2.3.4.4 Needles shall not be recapped prior to disposal.

2.3.4.5 There are two types of red “Sharps” containers available for the work area, those labeled with the universal biohazard label and those without. Biologically contaminated sharps shall be collected in “Sharps” containers bearing the biohazard warning label and kept separate from chemically contaminated sharps.

2.3.4.6 All types of sharps containers shall be turned in for proper disposal when almost full.

2.3.4.7 Never overfill the disposal container, as this increases the possibility for accidental injury.

2.3.5 Clean up shall follow the completion of any operation at the end of the day.

2.3.6 Access to exits, emergency equipment and/or controls shall never be blocked.
2.4 USE OF ELECTRONIC DEVICES

2.4.1 Employees shall not use devices that will distract their attention while engaged in hazardous operations or activities unless those devices are required to properly perform the operation or activity.

2.4.2 These devices include telephones, cell phones, smart phones, tablets, audio devices, radios, televisions, etc.

2.4.3 Hazardous operations include operations or activities that require constant attention/vigilance to prevent an undesired event which could result in death, personal injury, or damage to equipment.

2.5 EMERGENCIES

2.5.1 Reporting

2.5.1.1 All emergencies shall be reported by dialing 911 from any Center telephone or 757-864-2222 from a cellular telephone.

   Note: Dialing 911 from a cell phone at LaRC will direct calls to Hampton’s emergency dispatch, not LaRC’s emergency dispatch.

2.5.2 First Aid - Chemical Exposure

2.5.2.1 Basic first aid procedures shall be used as follows:

a. Eye Contact
   (1) Promptly flush eyes at an eyewash station for at least 15 minutes.
   (2) Be sure to open lids while flushing.

b. Skin Contact
   (1) Promptly flush and wash the affected area with soap and water.
   (2) If only the face is involved, the eye/face wash fountains can be used to flush the area with water.
   (3) Remove all contaminated clothing in a manner that avoids further skin contact.

c. Inhalation - Immediately exit from the exposure area to seek fresh air. If water reactive chemicals are inhaled, symptoms may be delayed. Medical attention should be sought immediately.

   Note: Always check the SDS for appropriate first aid response procedure prior to handling any chemical.
2.5.2.2 After the appropriate First-Aid has been applied, the affected personnel shall remain in a safe area until emergency personnel have arrived and assessed the situation.

2.5.3 Accidents - Non Chemical Exposure

2.5.3.1 Except in the event of a serious injury or illness, the injured person shall, with an escort, proceed immediately to the LaRC Clinic located at 17 Langley Blvd. (Building 1216) for treatment.

2.5.3.2 In the event of a serious injury or illness dial 911 from any Center telephone or 757-864-2222 from a cellular telephone.

2.5.3.3 All incidents shall be reported to the CHO/FSH and supervisor as soon as possible after receiving medical evaluation.

2.5.3.4 The CHO/FSH shall be responsible for notifying the SFAB Safety and Mission Assurance Office as soon as possible of all accidents, close calls, health-related incidents or spills that could cause serious health hazards.

2.5.4 Chemical Spills

    Note: Spill responses are detailed in Chapter 14 of LPR 8500.1

2.5.4.1 A small-scale spill that can be safely cleaned by the user, shall be neutralized and absorbed or otherwise managed by the user. The user shall, immediately after cleanup, report the spill to the CHO/FSH or his/her designee.

2.5.4.2 All laboratory personnel working with chemicals shall be knowledgeable in the proper use of spill kits (as defined in LPR 8500.1) and their location.

2.5.4.3 For spills that cannot be safely managed by the user, the contaminated area shall be cleared of all personnel, and the Fire Department notified immediately either by dialing 911 from any Center telephone or by dialing 757-864-2222 from a cellular telephone.

2.5.4.4 After emergency personnel, including the CHO/FSH or his/her designee or alternate are contacted, the chemical user shall secure the area until further instructions are issued.

2.5.4.5 In addition to notifying the CHO/FSH or his/her designee or alternate, the Standard Practice and Environmental Engineering Branch (SPEEB) shall be notified at 757-864-3500, in the event of a toxic chemical or oil spill that has the potential to contaminate the environment or represents a serious health hazard.
2.5.4.6 User responsibilities as outlined in this LPR shall be to maintain containment and clean-up supplies, identify the spilled material, estimate the volume, and clean up small-scale spills.

2.5.4.7 This LPR does not supersede LPR 8500.1 or other LaRC directives and procedural requirements concerning spill control.

2.5.5 Unscheduled Power Outage

2.5.5.1 All laboratories shall plan to safely secure operations in the event of an unscheduled power outage. Steps may include, but are not limited to:

a. Ceasing all chemical reactions/experiments if possible.

b. Turning off all heat sources.

c. Ensuring that all electrical sources are in the “OFF” position.

d. Leaving on all purges and cooling systems.

e. Closing all laboratory hood sashes.

2.6 EMPLOYEE EXPOSURE / PROTECTION

2.6.1 To protect employee health, LaRC uses the most conservative exposure limits to hazardous chemicals from the following sources:

a. The American Conference of Governmental Industrial Hygienists produces annual lists of Threshold Limit Values and Short Term Exposure Limits for common chemicals used in laboratories.

b. The National Institute of Occupational Safety and Health has developed recommended exposure standards.

c. OSHA has also developed regulatory standards called Permissible Exposure Limits (PELs), which define allowable maximum employee exposure levels.

2.6.2 Exposure to hazardous chemicals can be minimized by understanding the common routes of exposure.

a. Inhalation

   (1) Inhalation of toxic vapors, mists, gases or dusts can produce poisoning by absorption through the mucous membrane of the mouth, throat and lungs and can seriously damage these tissues by local action.

   (2) Adequate ventilation shall be provided to prevent inhalation exposure.
b. Ingestion
   (1) Many chemicals used in the laboratory are extremely dangerous if they enter
       the mouth and are swallowed.
   (2) To prevent entry of toxic chemicals into the mouth, laboratory workers shall
       wash their hands with soap and water before eating, smoking, or applying
       cosmetics, immediately after use of any toxic substance, and before leaving
       the laboratory.

c. Skin and Eye Absorption
   (1) Contact with the skin is a common mode of chemical injury. Chemicals enter
       the skin through hair follicles, sweat glands, and cuts or abrasions on outer
       layers of the skin. Some chemicals can be absorbed directly through the skin
       into the bloodstream. Skin can also be damaged by corrosives, which then
       allows chemicals to enter the body. Skin contact can be prevented by use of
       appropriate protective equipment.

d. Injection
   (1) Exposure to chemicals through injection is the least common exposure route.
       It is possible to be exposed to chemicals through mechanical injury from glass
       or sharp metal (such as needles or razor blades) contaminated with
       chemicals. Safe work practices are the best preventive measure for avoiding
       exposure through injection.

2.7 PERSONAL PROTECTIVE EQUIPMENT

2.7.1 Personal protective equipment that shall be worn in laboratories includes, but is
       not limited to:

a. Gloves
   (1) When handling any chemical, gloves shall be worn.
   (2) Contact the SFAB IH staff at 757-864-7233 for glove selection guidelines.

b. Hearing Protection
   (1) Whenever employee noise exposure exceeds 85 decibels, the employee shall
       wear hearing protection.
   (2) Hearing protection shall be worn if operating any equipment posted with
       hazardous noise warning or if working in a designated hazardous noise area.

c. Respirators
   (1) When exposures to dust, fumes, mist, radio-nuclides, gases, and vapors
       exceed established limits of exposure, respiratory protection shall be
       required.

d. Safety Glasses
   (1) Employees shall wear safety glasses with side shields at all times in
       laboratories.
(2) Operations that require improved protection against impact, liquid splash, and other eye hazards shall require safety goggles and/or face shields.
(3) All visitors entering laboratories shall be required to wear safety glasses.
(4) Contact lenses shall not be worn in work areas.
   (a) If contact lenses are needed for medical reasons, they shall be used in conjunction with goggles.
   (b) During an emergency contact lenses shall be removed before eye irrigation.
   (c) Contact the FSH or SFAB IH staff if you have a doctor’s recommendation to wear contact lenses.

e. Lab Coats
   (1) Shall be worn when working with chemicals to protect exposed skin and to prevent contamination of clothing.
   (2) All visitors entering laboratories shall be required to wear a Lab Coat.

2.7.2 Employees shall be trained in the proper use and maintenance of provided protective clothing and equipment, in accordance with Federal and Agency regulations.

2.7.3 Specific directives concerning the LaRC PPE program are referred to in LPR 1710.4 “Personnel Protection – Clothing and Equipment”

2.8 TRAINING

2.8.1 All personnel under a Potentially Hazardous Materials (PHM) permit or CHP shall complete general laboratory safety training offered by SFAB upon entry and refresher training every four years.

2.8.2 As soon as is practical after being hired, NASA personnel shall receive hazard communication training through courses provided by SFAB.

2.8.3 All personnel under a PHM permit or CHP shall be trained in the care, use and correct choice of PPE that will provide the most protection from exposure to hazards.

2.8.4 Contractors shall provide an equivalent program for on-site operations.

2.8.5 The CHO/FSH or designee shall provide additional training to cover elements of the CHP to all individuals upon entry and on an annual basis.

2.8.6 Supervisors and FSHs shall be trained regarding hazards and appropriate protective measures so they can be available to answer questions from employees and provide daily monitoring of safe work practices.

2.8.7 As new hazards are introduced, the CHP shall be updated and additional training shall be provided to all affected individuals. The supervisor is responsible for maintaining training records.
2.9 MEDICAL CONSULTATION/EXAMINATION

2.9.1 In accordance with LPR 1740.6 “Personnel Safety Certification” Chemical Workers shall undergo medical examination in accordance with LaRC Occupational Medical Examination Protocols (OMEPs).

2.9.1.1 Civil servants shall receive medical examinations at the occupational medicine clinic in building 1216, in accordance with LaRC OMEP’s.

2.9.1.2 Contracts issued by LaRC shall require the same level of examination for contract employees in accordance with LaRC OMEP’s.

2.9.1.2.1 Examination requirements of contract employees shall be the responsibility of the contracting company.

2.10 SAFETY DATA SHEET (SDS) PROGRAM

2.10.1 SDSs provide an excellent source of specific information on the chemicals which employees must handle. The SDS will inform you about the hazards posed by the chemicals you work with and how to protect yourself against those hazards, as well as how to respond to emergency situations.

2.10.2 OSHA requires all employers to maintain a complete and accurate SDS for each hazardous chemical used in facility research or maintenance operations. SDSs shall be readily accessible to employees in that facility.

2.10.3 All chemicals entering LaRC shall be accompanied by a SDS, whether the material was purchased or obtained as a complimentary sample. 29 CFR 1910.1200 and 29 CFR 1910.1450 require manufacturers/suppliers supply SDSs when a material is purchased.

2.10.4 No laboratory work shall be started unless a SDS for each chemical being used is present in the Chemical Material Tracking System (CMTS). This is the primary location of all SDS’s.

2.10.4.1 SDSs shall be readily available in the CMTS database at https://emis.ndc.nasa.gov/cmts/index.htm.

2.10.4.2 Additional copies of SDS’s may be available within the facility.

2.10.5 SDSs for new chemicals shall be obtained from the manufacturer and entered into CMTS when the chemicals are ordered.

2.10.6 SDSs shall be updated as per LPR 1710.12 chapter 4.
2.10.7 Experimental materials that are generated on-site, for on-site use, are not required to have a SDS generated. Information on the known hazards of the materials shall be communicated to all users.

2.11 CONTAINER WARNING LABELS AND HAZARD INFORMATION

2.11.1 All chemical containers shall be properly identified and labeled, as per Chapter 6 in LPR 1710.12.

2.11.2 Containers of experimental materials generated on-site shall be labeled:

a. With the name of the material, or

b. With the citation in the researchers’ lab book that references the precursor materials.

2.11.3 The National Fire Protection Act (NFPA) diamond label with the material name or trade name shall be placed on hand-carried containers (e.g., beakers, flasks) whenever possible.

2.11.4 Unlabeled containers shall not be permitted in the laboratory.

2.11.5 Chemicals that will be hand-carried between laboratories shall be labeled as to their contents and hazards.

2.11.5.1 Chemicals that will be hand-carried between facilities shall be labeled as completely as possible, including the name, address, and telephone number of the sender and recipient for samples in transit.

2.11.5.2 Chemicals being hand-carried shall be placed inside a carrier or secondary container to protect them from damage if dropped during transit.

2.11.6 Chemical containers shall be maintained in good condition.

2.11.6.1 Materials within containers with only minor damage shall be properly and safely re-packaged by the user.

2.11.6.2 Chemical containers with significant damage or containers of unknown structural condition, and which are not creating an immediate hazard to nearby personnel, should not be handled. The SFAB should be contacted immediately at 4-7233 (4-SAFE) so that the condition of the container can be assessed and recommendations for disposal can be made.
2.11.6.3 If materials are discovered in significantly damaged containers and the materials are being released into the environment and creating a hazard to nearby personnel, the area should be evacuated and secured, and 911 shall be called.

2.12 HAZARDOUS WASTE HANDLING AND DISPOSAL

2.12.1 "Laboratories are required to manage all hazardous waste in accordance with Federal, State, and Local regulations, as well as LPR 8500.1

2.12.2 All hazardous waste containers shall be accumulated in a Satellite Accumulation Area (SAA). Specific SAA requirements can be found in LPR 8500.1, chapter 7 "Facility Accumulation Procedures"

2.12.2.1 Containers shall be arranged so they are easily accessible. This will ensure that containers will not be damaged during handling.

2.12.2.2 Only chemically compatible containers of sufficient strength shall be used to accumulate waste.

2.12.2.3 All containers that contain materials designated as hazardous waste containers shall be marked with the words "Hazardous Waste" and the identity of significant constituents of the waste.

2.12.2.4 Containers used for accumulation of waste shall be labeled from the outset so that anyone working in the area will be aware of the contents. It is best to keep waste separated based on particular operations as much as possible, (i.e., do not mix all solvents from different operations or chemical syntheses together).

2.12.2.5 An LF 163 shall be filled out by the generator of the waste on each item to be disposed of. Specific hazardous waste disposal procedures can be found in LPR 8500.1, Chapter 7.

2.12.3 Specific hazardous waste disposal procedures can be found in LPR 8500.1, Chapter 7.

2.12.4 The Facility Environmental Coordinator (FEC) or SPEEB shall be contacted whenever questions occur about proper disposal methods for an item.

2.12.5 Petroleum Hydrocarbons

a. All used oils and oily debris shall be kept separate from other chemical wastes.

b. Wastes shall be labeled properly and deposited in appropriate containers.
c. Waste labels are available from the SPEEB (757-864-3500).
Chapter 3

3.0 PROCEDURES FOR WORKING WITH SPECIFIC CHEMICAL CLASSES

3.1 HANDLING OF HAZARDOUS MATERIALS

3.1.1 Only trained personnel shall be allowed to handle acids, bases, corrosives, toxic chemicals, and any other hazardous materials as defined in this chapter.

3.1.2 Students under the age of eighteen (18) are not permitted to work with, handle or have exposure to hazardous materials.

3.1.3 All contact of vapor or liquid with skin, eyes, or mucous membranes shall be prevented.

3.1.4 PPE shall include safety glasses, goggles, or a face shield, and lab coat, as specified in Chapter 2.7.

3.1.5 Full-length sleeves and the appropriate gloves shall be worn.

3.1.6 Those working with hazardous agents shall ensure there is adequate ventilation.

3.1.7 Hazardous chemicals shall be handled in a lab hood. If the work cannot be conducted in a lab hood, respiratory protection may be required.

3.1.7.1 Laboratory hoods shall be inspected for proper operation before work begins.

3.1.7.2 The SFAB shall be contacted for work conducted outside of a lab hood, to determine if respiratory protection is required, and to determine the appropriate respiratory protection for the task.

3.1.8 Chemical-specific OSHA regulations are found in 29 CFR 1910 Subpart Z - Toxic and Hazardous Substances

3.1.9 The location of the nearest safety shower and eye wash station shall be noted before beginning work.

3.1.10 Accident Response

a. In case of a medical emergency exposure, 911 shall be dialed from any Center telephone or 757-864-2222 from a cellular telephone.

b. An appropriate spill plan for large and small quantities shall be established.
c. Establish a controlled area/perimeter around any spill.

d. Potential spills shall be anticipated.

e. Only individuals wearing the appropriate protective clothing shall clean up spills.

f. Spill pads shall be used to make clean up easier.

g. Amounts of spill pads reflective of quantities likely to be encountered in spill situations shall be stocked.

h. Appropriate containment materials shall be on hand in case of large spills.

i. The CHO/FSH or his/her designee shall be notified immediately.

3.1.11 Transfer and Transport

a. The appropriate PPE shall be used.

b. The chemical compatibility of transfer pumps and receiving vessels shall be verified.

c. Bottle carriers shall be used when transporting small quantities to prevent breakage and to act as a containment vessel should breakage occur.

d. Transfers shall use chemical carriers or secondary containment.

e. All transfers shall be conducted in a controlled area.

f. All materials shall be marked and properly labeled as per LPR 1710.12

3.2 ACIDS

3.2.1 An acid is a substance that yields hydronium ions when dissolved in water. As a group, acids are highly reactive. This reactivity adds to their usefulness, but also demands that laboratory spills be given special attention.

3.2.2 Additional safety precautions when working with acids;

a. Acids shall be used under well-ventilated conditions.

b. Aprons made of acid-resistant material shall be worn as necessary.

c. When diluting acids with water, always add the acid to the water, not the water to the acid.

3.2.3 Storage
3.2.3.1 Acids shall be segregated, preferably in separate cabinets, from active metals, oxidizing acids, incompatible acids (inorganic/organic), flammables and combustibles, bases, and chemicals that react with acids to form toxic gases.

3.3 BASES/CAUSTICS

3.3.1 Bases are substances that yield hydroxyl ions when dissolved in water. The major hazard in the use of bases is their corrosive action on tissue. Severe, painful tissue damage can rapidly result from acute exposures in which significant amounts of bases are inhaled, splashed on the skin, or swallowed.

3.3.2 Additional safety precautions when working with bases/caustics
a. Workers shall be cautioned to check themselves over thoroughly after working around bases to ensure that no clothing or skin has been exposed.

b. There is no warning sting with bases, as with acids, and an unattended burn can make considerable headway before it is noticed.

3.3.3 Storage

3.3.3.1 Bases shall not be stored with acids. The reaction between the two will generate large quantities of heat.

3.3.3.2 As most bases are non-volatile, special storage cabinets are not necessary.

3.4 OXIDIZERS

3.4.1 Oxidizers will react violently with flammables and combustibles, and shall be separated from flammables and combustibles as well as reducing agents.

3.4.2 Additional safety precautions when working with oxidizers;

a. Unintentional contact with organic and other oxidizable substances shall be avoided.

b. Reaction vessels containing significant quantities of these reagents shall be heated using fiberglass mantles or sand baths rather than oil baths.

3.4.3 Accident Response

3.4.3.1 Chemically resistant trays and spill pads shall be used to make clean-up easier.

3.4.3.2 Organic materials, such as paper towels or cotton rags, shall not be used for clean-up of oxidizer spills.
3.4.4 Storage

3.4.4.1 Oxidizers shall not be stored with organics or other oxidizable compounds as they initiate or promote combustion.

3.4.4.2 Oxidizers shall be stored in glass or unbreakable inert containers.

3.4.4.3 Corks and rubber stoppers shall NOT be used.
Chapter 4

4.0 PROCEDURES FOR WORKING WITH TOXIC SUBSTANCES

4.1 HANDLING OF TOXIC SUBSTANCES

4.1.1 These chemicals are particularly hazardous substances that include, but are not limited to, select carcinogens, reproductive toxins, and substances that have a high degree of acute toxicity.

Note: Information about toxic substances and how they affect your health can be found at The Agency for Toxic Substances and Disease Registry website  https://www.atsdr.cdc.gov/substances/index.asp

4.1.2 Handling of toxic substances and accident response for toxic substances is the same as in Chapter 3.0 Hazardous Materials.

4.1.3 Additional safety precautions when working with toxic substances;

a. These chemicals shall be used only in a controlled area (a laboratory, or portion of a laboratory or a facility such as an exhaust hood that is designated for use of highly toxic substances).

b. All personnel who have access to the controlled area shall be aware of the substances being used and the necessary precautions.

c. Follow all recommended work practices and wear appropriate PPE, especially gloves.

d. The controlled area shall be conspicuously marked with warning and restricted access signs.

e. Use of this area shall not be limited to toxic substances, but additional safety precautions must be followed at all times that toxic substances are present.

f. Toxic compounds shall be handled with adequate ventilation.

g. Toxic compounds shall be stored in properly labeled, non-breakable containers.

h. Chemical decontamination shall be used whenever possible.

i. Vacuum pumps shall be protected against contamination by scrubbers or cold traps and vented into an approved exhaust system.
j. Any protective apparel shall be removed and placed in an appropriate labeled waste container upon leaving a controlled area.

k. Hands, forearms, face, and neck shall be thoroughly washed with soap and water after handling chemicals.

l. The work area shall be decontaminated before normal work is resumed.

4.1.4 The user shall contact the CHO/FSH or his/her designee or SFAB for guidance in determining the need for a PHM permit.

4.2 REPRODUCTIVE HAZARDS

4.2.1 Reproductive and developmental hazards can result from exposures of shorter duration and at a lower level than those considered safe for most employees. LaRC strives to keep exposures as low as reasonably practicable, below published regulatory and recommended limits.

4.2.2 Exposure of both male and female workers to specific chemicals during the reproductive cycle can have an effect on the development of a fetus.

4.2.3 Additional safety precautions when working with reproductive hazards;

a. Both men and women of childbearing age shall always take adequate precautions to guard against inhalation, direct skin contact, or accidental ingestion of chemicals known to be reproductive hazards.

b. Chemicals, which may be reproductive hazards, shall be labeled as such.

4.2.4 Some of the reproductive hazards that may be found in LaRC laboratories include:

Hexanes
Hydroquinone
Methanol
Methylene Chloride
MDA, Methyleneedianiline (4,4-)
N-Methyl-2-Pyrrolidone
Oxalic acid, 98%
Tetrahydrofuran (PHT as inhibitor 99.9%)
Toluene
Trichlorobenzene (1,2,4-)
Trichloroethylene

4.2.5 The FSH and supervisor shall be notified of pregnancy as soon as possible.
4.2.6 Pregnant employees shall be allowed to work in the laboratory only after a thorough evaluation of the hazards has been conducted by the supervisor and the employee’s doctor.

4.2.7 Storage

4.2.7.1 Reproductive hazards shall be stored in properly labeled, non-breakable containers in a well-ventilated area.

4.3 SELECT CARCINOGENS

4.3.1 Select carcinogen means any substance which meets one of the following criteria:

a. Any material for which OSHA has promulgated an emergency temporary or permanent standard that reflects its carcinogenic potential.; or

b. It is listed under the category, "known to be carcinogens," in the Annual Report on Carcinogens published by the National Toxicology Program (NTP), latest edition; or

c. It is listed under Group 1 ("carcinogenic to humans") by the International Agency for Research on Cancer Monographs (IARC), latest editions; or

d. It is listed in either Group 2A or 2B by IARC or under the category, "reasonably anticipated to be carcinogens" by NTP, and causes statistically significant tumor incidence in experimental animals.

4.3.2 Storage

4.3.2.1 Carcinogens shall be stored in properly labeled, non-breakable containers in a well-ventilated area.

4.4 SENSITIZERS

4.4.1 Sensitizers include:

a. Respiratory Sensitizer – induces hypersensitivity of the airways following inhalation of the chemical.

b. Skin Sensitizer – contact can develop into allergic reaction in normal tissue after repeated exposure to the chemical.

4.4.2 Additional Safety Precautions When Working with Sensitizers

4.4.2.1 Suitable gloves and clothing shall be worn to prevent skin contact with sensitizers or substances of unknown sensitizing potential.
4.4.3 Storage

4.4.3.1 Breakable containers shall be stored in chemically resistant trays.

4.4.3.2 Contaminated waste shall be stored in labeled impervious containers.

4.4.3.3 Liquid waste shall be stored in glass or plastic bottles.

4.5 HIGHLY TOXIC CHEMICALS

4.5.1 Highly toxic chemicals include:

a. Acutely toxic chemicals, which cause damage in a relatively short time after a single concentrated dose. Irritation, burns, illness, or death may result; and

b. Extremely Chronic toxic chemicals, which are substances that cause irreversible neurological damage or death with extremely small doses.

4.5.2 Additional safety precautions when working with extremely chronic or acutely toxic chemicals include:

a. Users must familiarize themselves with the specific hazards of the compounds they are working with.

b. If dry powder is used, wet mops or a High Efficiency Particulate Air (HEPA) exhausted vacuum cleaner shall be used instead of dry sweeping. Hand-held vacuum cleaners are not HEPA exhausted units.

c. The user shall ensure that containers of contaminated waste, including washings from contaminated flasks, are transferred from the controlled area in a secondary container.

4.5.3 Storage

4.5.3.1 All containers shall be labeled with the appropriate identification and warning labels.

4.5.3.2 Containers of highly toxic chemicals shall be stored only in ventilated limited access areas in labeled, unbreakable, chemically resistant, secondary containers.
Chapter 5

5.0 PROCEDURES FOR WORKING WITH FLAMMABLES / EXPLOSIVES AND OTHER HAZARDS

5.1 FLAMMABLES

5.1.1 Flammables include;

a. Flammable liquid means any liquid having a flashpoint below 100°F (37.8°C) or higher, the total of which make up 99 percent or more of the total volume of the mixture.

b. A flammable gas is any material which is a gas at 68°F or less at 14.7 psi of pressure and when in mixture of 13 percent or less by volume with air or has a flammable range in 14.7 psi with air of at least 12 percent regardless of the lower limit.

5.1.2 Additional safety precautions when working with flammables/explosives;

a. Flammable substances shall be handled only in areas free of ignition sources.

b. Flammable substances shall never be heated using an open flame.

c. A steam, water, oil, or air bath or a heating mantle shall be used.

d. Adequate ventilation shall be used to prevent the formation of flammable atmospheres.

5.1.3 Accident Response

5.1.3.1 Clean-up of accidental spills of many hazardous (flammable) materials may require the use of non-sparking tools. The SDS shall be reviewed to determine the appropriate tools for clean-up.

5.1.4 Transfer and Transport

5.1.4.1 When transferring these substances in metal and plastic containers, static generated sparks shall be avoided by bonding and the use of ground straps.

5.1.5 Storage

5.1.5.1 Flammable materials shall be stored in flammable solvent cans per NFPA 45.

5.1.5.2 Flammable substances shall be kept in special cabinets designed for this purpose.
5.2 PEROXIDES

5.2.1 Peroxides are unstable and pose a risk of explosion.

5.2.1.1 Peroxide-forming chemicals react with oxygen present in the atmosphere to form peroxides.

5.2.1.2 The concentration of the peroxide contaminant plays an important role and can change through evaporation and distillation processes.

5.2.1.3 Heat, shock, and friction can create dangerous situations, which can lead to explosions.

5.2.2 A list of peroxide forming compounds can be found in LPR 1710.12, Storage Time Limits of Peroxidizable Compounds.

Note: Aging of the chemical is a significant factor in the production of peroxides. Peroxide-forming compounds often contain additives to prevent the formation of peroxides. However, the addition of additives delays but does not eliminate the hazard. More information can be found in LPR 1710.12. The procurement, storage, handling, use, and disposal of explosive materials are referenced in LPR 1710.7.

5.2.3 Additional Safety Precautions When Working with Peroxide-Forming Compounds

5.2.3.1 These substances shall be purchased in small quantities, not stockpiled.

5.2.3.2 Unused peroxide-forming compounds shall not be returned to the container.

5.2.3.3 Containers of peroxide-forming compounds shall be tested for peroxides quarterly.

5.2.3.4 Containers of aged or expired peroxide-forming compounds shall not be opened unless they have been tested within the past 90 days.

5.2.3.5 Solutions of peroxides in volatile solvents shall be handled so as to prevent evaporation of the solvent as the peroxide concentration will increase.

5.2.3.6 The user shall not open any container having obvious crystal formation around the lid.

5.2.3.7 Metal spatulas shall not be used to handle peroxides, because metal contamination can lead to explosive decomposition.

5.2.3.8 Ignition sources shall not be permitted in the area.
5.2.3.9 Friction, grinding, and other forms of impact shall be avoided.

5.2.3.10 Any questions should be forwarded to the Explosives Safety Officer at 4-7233 (4-SAFE).

5.2.3.11 Liquid spills shall be absorbed with vermiculite.

5.2.4 Transfer and Transport

5.2.4.1 Small quantities of peroxides shall be handled so as to avoid ignition sources, shock and extreme temperature changes.

5.2.5 Storage

5.2.5.1 Peroxide-forming compounds shall be stored in airtight containers in a cool, dry, dark place.

5.2.5.2 Peroxide-forming compounds shall not be refrigerated or frozen unless recommended by the manufacturer.

5.2.5.3 Glass containers that have glass stoppers shall not be used.

5.2.5.4 Chemicals shall be stored in the original container supplied by the manufacturer.

5.2.5.5 To minimize the rate of decomposition, peroxides shall be stored at the lowest temperature consistent with their solubility or freezing point, but not lower, because they may become more sensitive to shock and heat.

5.2.5.6 These chemicals shall be properly labeled with the receiving date, the opening date, the peroxide test date, and the date recommended for disposal.

5.2.5.7 The recommended disposal date shall also be tracked within CMTS in the expiration section.

5.2.5.8 These chemicals shall be properly disposed of upon expiration and after they have been tested for peroxides.

5.2.5.9 Metal containers with screw lids shall be avoided.

5.2.5.10 The CHO/FSH, his/her designee or alternate shall be notified immediately if old bottles of these materials are discovered, especially if they are in poor condition.

5.3 PYROPHORICS

5.3.1 General Information and Storage Requirements
5.3.1.1 Pyrophorics are liquids or solids that will spontaneously ignite in air at temperatures less than 130°F.

5.3.1.2 These substances shall be stored in inert atmospheres or under kerosene.

5.4 COMPRESSED GASES

5.4.1 Any gas stored or used from a compressed gas cylinder has the hazard of rupture and/or explosive force on release that is normally associated with that of high-pressure vessels or systems.

5.4.2 Compressed gases present the potential for exposure to both chemical and mechanical hazards depending on the particular gas.

5.4.3 Additional Safety Precautions When Working with Compressed Gas

a. The contents of any compressed gas shall be clearly identified on the cylinder.

b. Signs identifying flammable compressed gases shall be clearly posted.

c. All gas lines shall be clearly labeled so as to identify the gas being transported.

d. Cylinders shall be firmly secured at all times using a clamp and belt or chain.

e. Cylinders shall be placed in such a way that the cylinder valve is readily accessible at all times.

f. The main cylinder valve shall be closed whenever the gas is not in use.

g. All pressurized systems shall have appropriate pressure relief devices in accordance with LPR 1710.40, Langley Research Center Pressure Systems Handbook.

h. Pressure release equipment for protecting devices attached to cylinders containing potentially hazardous gases shall be vented to the outside or into an appropriate exhaust system.

i. All pressure regulators shall be equipped with spring-loaded pressure relief valves.

j. Common brass pressure regulators shall not be used with corrosive gases.

k. Regulators used with carbon dioxide shall have special internal designs and special materials to prevent freeze-up and corrosion problems.

l. Internal bleed type regulators shall not be used.
m. Valves shall be opened slowly, and it is never necessary to open the main valve all the way.

n. When opening a cylinder containing toxic gas, workers shall stand upwind and to the side or use proper ventilation equipment.

o. Pliers shall not be used on cylinder hardware.

p. All piping, regulators, appliances, and hoses shall be kept tightly sealed and in good condition.

q. Equipment used for flammables shall not be interchanged with similar equipment used for other gases.

r. Sparks and flames shall be kept from the area of flammable gas cylinders.

s. Cylinders shall not be emptied less than 172 kPa (25 lbf/in²) because the residuals may become contaminated if the valve is left open.

t. Labels shall be used to designate whether cylinders are full, in use, or empty.

u. The regulator shall be removed when not in use.

v. The valve cap shall be replaced when not in use.

w. Empty cylinders shall not be refilled.

x. All pressure equipment shall be inspected periodically, more often where corrosive or hazardous gases are used.

5.4.4 Storage

5.4.4.1 Cylinders containing flammables or toxic gases shall be stored in gas storage lockers vented to the outside or stored outside the facility.

5.4.4.2 Cylinders of oxygen shall never be stored with cylinders containing flammables.

5.4.4.3 Empty and full cylinders shall not be stored in the same location.

5.4.4.4 Cylinders shall not be laid on the ground.

5.5 CRYOGENS

5.5.1 Some gases normally used in the form of cryogenic liquids or solids have hazards associated with their use.
5.5.1.1 The low temperatures present in cryogenic liquids or solids may cause local freezing hazards to personnel exposed for a sufficient length of time.

5.5.1.2 The powerful oxidizers, liquid O2 and F2, shall be protected from contact with organic materials or fuels as explosive reactions may result.

5.5.1.3 Liquid nitrogen (LN2), although a relatively inert gas, also has the following hazards:

a. If spilled or allowed to evaporate quickly in large quantities in confined areas, can greatly dilute or replace the O2 of the air so that asphyxiation will ensue.

b. LN2 gas can condense the O2 from the air, making a mixture of LN2 and O2 that may assume some of the hazards of liquid O2, that is, violent reaction with organic compounds.

5.5.2 General safety precautions for cryogenic liquid gases.

a. Equipment shall be used (e.g. cryogenic gloves, aprons, eye protection) to guard against freezing and avoid spills or very rapid evaporation into an enclosed area.

b. Oxygen deficiency alarm monitors shall be located in areas where cryogens are handled and spills may occur.

c. Areas where large quantities of cryogens are used on a routine basis shall have a permanent oxygen monitoring system that is connected to the facility fire alarm system.

1) The oxygen monitoring system shall sound an alarm at 19.5 percent oxygen and shall activate audio and visual (blue strobe light) alarms in the local area.

2) The oxygen monitoring system shall activate the fire alarm system and evacuate the facility at 16.5 percent oxygen.

3) Signage shall be posted near the blue lights describing the emergency action to be taken.

d. Areas that use small quantities of cryogens on an infrequent basis can use approved portable oxygen monitors.

e. All oxygen monitoring systems shall be routinely calibrated per the requirements of the LaRC Metrology Program.

f. Positive ventilation, and in the case of flammable and explosive gases, spark and explosion-proof fan motors and electrical equipment, shall be provided.
5.6 WATER REACTIVE CHEMICALS

5.6.1 General Information and Storage Requirements

5.6.1.1 Water reactive chemicals can lead to the formation of flammable toxic gases or release of an extreme amount of energy following contact with water.

5.6.1.2 Areas where water reactive compounds are present shall be posted in such a way that fire-fighting personnel are aware of their presence.

5.6.1.3 Water reactive chemicals shall be stored in accordance with the manufacturer’s recommendations.
6.0 PROCEDURES, ACTIVITIES, OPERATIONS REQUIRING PRIOR APPROVAL BEFORE IMPLEMENTATION

6.1 GENERAL

6.1.1 In the interest of integrating safe laboratory practices, whenever a particular procedure, operation, or activity is to involve the use of carcinogens, reproductive toxins and/or substances with a high degree of acute or chronic toxicity, the FSH and the SFAB at 864-7233 shall be informed during the planning stages.

6.1.1.1 The Principle Investigator shall investigate the toxicity of materials of interest and inform the FSH in writing the plans.

6.1.1.1.1 This is accomplished through the filing of a LF 118, “Safety Permit Request.” In accordance with LPR 1710.12 and OSHA 29 CFR 1910.1450, prior approval shall be given before beginning work with hazardous materials.

6.1.2 Examples of activities and operations requiring prior review and approval before implementation are given below:

a. Use of OSHA regulated carcinogens and gases with Immediately Dangerous to Life or Health (PEL)s < 5000 ppm.

b. Any new or radically modified experiment, including scale-ups where greater than 4 liters of highly toxic substances shall be used.

c. Any new activity, that will involve the use of high temperature (>500° C) and/or pressure (125 PSIA).

d. Any activity that will utilize a toxic substance for an extended period of time. This includes storage as well as handling times.

e. Any activity utilizing a substance requiring special disposal or storage requirements for itself or its derivatives.

f. Any activity involving the use or synthesis of organometallic materials.

6.2 DESIGNATED WORK AREAS

6.2.1 Designated work areas shall be established for work involving the use of carcinogens, reproductive toxins, and or substances with a high degree of acute toxicity.
6.2.2 Laboratory hoods shall be identified throughout the area of such work. Signs can be obtained through the FSH or SFAB IH staff.
Chapter 7

7.0 LABORATORY HOOD PROGRAM

7.1 INTRODUCTION

7.1.1 Operations involving toxic or unknown gases, vapors, aerosols, and dusts shall be performed in a laboratory hood. Hoods offer significant employee protection. They prevent toxic, unknown, offensive, or flammable vapors from entering the general laboratory atmosphere, they place a physical barrier between the workers and the chemical environment, and they provide an effective containment device for accidental spills of chemicals.

7.1.2 Laboratory hoods shall remain on at all times.

7.1.3 The sash shall be maintained at the lower extreme when not actively being used and within the proper positioning range when physical protection is needed.

7.2 VENTILATION SPECIFICATIONS

7.2.1 All new, existing, or upgraded laboratory hoods intended for use with any material shall attain an average linear face velocity of 100 feet per minute, with the sash fully opened or lowered to a minimum, allowable working sash height of 12”.

7.2.2 If the hood face opening has to be reduced to achieve 100 fpm or a high velocity for a particular hood use, then visible markings shall clearly indicate the working sash height. (Directional arrows are used on all hoods to designate the proper working sash height).

7.2.3 All hoods shall be designed and operated to maintain relatively uniform air velocity over the entire face.

7.2.3.1 As a general rule, the velocity measured at any single point shall not vary more than 20 percent from the overall average.

7.3 LABORATORY HOOD GUIDELINES

7.3.1 The SFAB IH staff shall inspect existing laboratory hoods for proper use, air turbulence, and adequate face velocity at least annually and after any significant adjustment or modification that could affect performance.

7.3.2 Lab hood inspection results shall be visibly posted on the front of the hood.

7.3.3 New hoods shall be inspected at the time of installation and before use.
7.3.4 Hood Baffle Adjustment

7.3.4.1 The baffle adjustment controls shall be utilized to attain uniform face velocity.

7.3.4.2 High heat loads are best controlled by fully opening the top slot.

7.3.4.3 Heavier-than-air vapors are best controlled by increasing the bottom slot opening and decreasing the top slot opening.

7.3.4.4 Avoid shutting off an exhaust slot completely.

7.3.5 General Requirements

7.3.5.1 Large bulky objects and hood clutter are detrimental to hood performance. Too much equipment and bulky objects in the hood are common causes of poor air performance, i.e., air turbulence and dead space.

7.3.5.2 Work being performed in the hood shall match the type of hood systems.

7.3.5.3 Work shall be placed well inside the hood. The forward six inches of the hood are most subject to draft and turbulence.

7.3.5.4 Materials shall be poured, transferred and weighed as far back as possible.

7.3.5.5 Placing your head inside the hood shall be avoided.

7.3.5.6 The hood sash shall be maintained at the smallest practical open area.

7.3.5.7 The hood shall be kept clean.

7.3.5.8 Spills shall be cleaned immediately to avoid build-up of contaminants within the hood.

7.3.5.9 Laboratory hoods shall be equipped with an airflow measurement device to warn if ventilation fails, is inadvertently turned off, or falls below a predetermined unacceptable value for the work being performed.

7.3.5.10 A hood suspected of not performing properly shall be promptly brought to the attention of FSH, his/her designee or contact SFAB (4-SAFE).

7.3.5.11 Hoods that are not performing properly shall be posted by SFAB.

7.3.5.12 The hood shall be removed from service until adequate airflow has been verified.
7.3.5.13 All operations involving perchloric acid shall be performed in lab hoods that are designed for perchloric acid use, or under a PHM Safety Permit as prescribed in 1710.12, Chapter 5.
Appendix A

DEFINITIONS

A.1 Acute Exposure  Short duration contact, typically minutes or hours.

A.2 Carcinogen(ic)  Capable of causing cancer. (NOTE: MSDSs are required to list any carcinogens present.)

A.3 Center  NASA Langley Research Center

A.4 Cryogenic  Maintained at extremely low temperatures.

A.5 IDLH  Immediately Dangerous to Life or Health Concentration. Concentration at which serious health impairments, or irreversible biological effects possibly leading to death in a period of seconds or several days later, could occur.

A.6 Narcotic  Capable of causing depression of the central nervous system; drowsiness, stupor, loss of coordination, unconsciousness.

A.7 PEL (Permissible Exposure Level)  Airborne concentration exposure standards are specified by Federal Regulation (OSHA, 29 CFR). Concentrations may be for 8-hour workdays or shorter periods (usually 15 minutes). (See also Threshold Limit Values.)

A.8 TLV (Threshold Limit Value)  Airborne concentration at or below which it is believed nearly all workers may be repeatedly exposed day after day with no adverse effect. Usually expressed in parts per million (ppm) for gases or vapors and milligrams per cubic meter (mg/m3) for dusts, fumes, and mists. Threshold Limit Values are specified by the American Conference of Governmental Industrial Hygienists and several have been adopted for use by OSHA.
ACRONYMS

ACGIH  American Conference of Governmental Industrial Hygienists

CFR   Code of Federal Regulations

CHO   Chemical Hygiene Officer

CHP   Chemical Hygiene Plan

CMTS  Chemical Material Tracking System

FSH   Facility Safety Head

IARC  International Agency for Research on Cancer

IH    Industrial Hygiene

LaRC  Langley Research Center

LN₂   Liquid nitrogen

LF    Langley Form

LPR   Langley Procedural Requirement

NFPA  National Fire Protection Act

OMEP  Occupational Medical Examination Protocols (OMEPs)
O₂  Oxygen

PHM  Potentially Hazardous Materials

PPE  Personal Protection Equipment

PEL  Permissible Exposure Limits

RCRA  Resource Conversation and Recovery Act

SAA  Satellite Accumulation Area

SDS  Safety Data Sheet

SFAB  Safety and Facility Assurance Branch