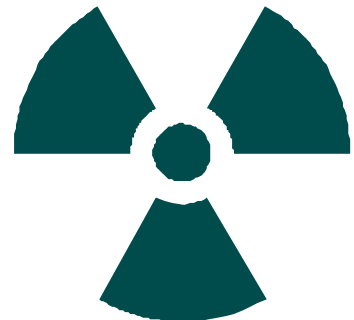


State Of Maryland
Department of Health and Mental Hygiene
Laboratories Administration
1770 Ashland Avenue
Baltimore, Maryland 21205

Laboratory Safety Manual

6.0 Edition
ISO QA-SOP-TR 5.03

Manual Issued To



PREFACE

This *Laboratory Safety Manual* brings together information that will assist both you and your supervisors to meet bio-security responsibilities through a formal safety program. “Bio-security” refers to a broad program of preventive medicine designed to protect the health of employees who may encounter biological, chemical, or radiological hazards in the laboratory or field.

The success of our safety program depends upon you having the necessary knowledge to carry out the program. When you are aware of risks, you are less likely to be a victim. Everyone who works in a biological or chemical laboratory should have this knowledge. It includes knowing how to protect yourself and your co-workers, and how to respond to such laboratory emergencies as exposure of an individual to, or contamination of the physical environment with dangerous microorganisms, radionuclides or chemicals.

The degree to which safe practices are observed in a laboratory stems directly from the attitudes and actions of the people in charge. The responsibility for enforcing the Safety Program ultimately rests with the Laboratory Director; however, immediate responsibility rests with every supervisor and employee.

Supervisors must see that each member of their staff understands the applicable contents of this safety manual. Supervisors must also oversee and demand the observance of the policies in the manual. Supervisors must educate themselves as fully as possible about potential hazards, and relay this information to their employees.

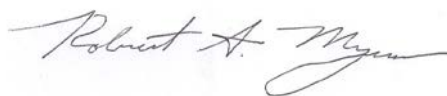
Every employee is highly trained and a valuable resource. I do not want to see you injured by a needless accident. Remember that you are the only person who can truly practice safe procedures for your own protection and that of your fellow co-workers. Therefore, you are required to know, understand and adhere to the safety policies in this manual. They are designed to maintain your health.

Robert Myers, Ph.D.
Director
Laboratories Administration

This *Laboratory Safety Manual* has been reviewed and approved for distribution to DHMH Laboratories Administration employees.

4/1/2017

Date



Signature

State of Maryland
Maryland Department of Health and Mental Hygiene
Laboratories Administration

Annual Review of the *Laboratory Safety Manual*

The Laboratories Administration *Laboratory Safety Manual* will be reviewed on an annual basis. This review may take the form of a Drill or Exercise, a Table-Top Exercise, an After-Action Report/Review of an actual event, or a Document Review of the Safety Manual. The annual review is a requirement to verify the Plan's effectiveness, and will be documented using this form.

This review is a (n) (check all that apply):

☐ **Drill/Exercise**

List all parties participating and the scenario used for the exercise. Include any pertinent problems or questions that arise. Attach additional documentation to this sheet.

☐ **Table-Top Exercise**

List all parties participating and the scenario used for the exercise. Include any pertinent problems or questions that arise. Attach additional documentation to this sheet.

☒ **Document Review of the *Laboratory Safety Manual***

A Document Review states that the *Laboratory Safety Manual* has undergone a thorough evaluation, and does not require any additional modifications or further review at this time. No additional attachments are needed.

☐ **After-Action Report/Review of an Actual Event**

If an event requiring the implementation of the *Laboratory Safety Manual* takes place, the event may be substituted for a Document Review and/or a Table Top Exercise. Attach additional documentation providing a summary of the event, and a full explanation as to how the *Laboratory Safety Manual* was employed, as well as any problems that arose pertaining to the Plan.

Review Conducted By: Rachel T. Michael
Safety & Security Officer

Date: 4/3/2017

Review Signed Off By: Robert A. My
Laboratory Administration Director

Date: 04/03/2017

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Maryland Department of Health and Mental Hygiene
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Review Conducted By: _____ Date: _____
Safety & Security Officer

Review Signed Off By: _____ Date: _____
Laboratory Administration Director

Laboratory Safety Manual

Revision History

REVISION	COMMENTS	DATE
Original	United States Department of Labor, Occupation Safety and Health Administration (OSHA) mandated that all laboratories develop and enforce safety standards for response to hazardous chemical emergencies, employee awareness and right-to-know chemical information, as well as laboratory safety standards.	March 1988
Second Version	Laboratory Safety Manual revised.	July 1988
2 nd Edition	Laboratory Safety Manual rewritten and updated.	May 1994
3 rd Edition	Laboratory Safety Manual rewritten, reformatted, and updated.	January 2002
4 th Edition	Laboratory Safety Manual rewritten, reformatted, and updated.	October 2009
4.1 Edition	Laboratory Safety Manual revise, contact information updated and ISO, QA-SOP-TR 5.03	July 2010 July 2011 July 2012 July 2013 July 2014
5.0 Edition	Laboratory Safety Manual rewritten and updated for new facility 1770 Ashland Ave.	2015
5.1 Edition	Laboratory Safety Manual reviewed and updated the glove personal protection equipment selection guidelines and Appendix B.	6/15/2016
6.0	Laboratory Safety Manual revised and updated State Maryland's new health care provider WorkPro and Occupational Medical Services (OMS) effective April 1, 2017.	4/1/2017

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1770 Laboratory Emergency Telephone Numbers

Fire and Ambulance	443-681-3911
Police/Security	443-681-3911
Medical Emergencies	443-681-3911
Lab Accidents	443-681-3792
Preventive Maintenance Shop	443-681-3794
Lab Waste Disposal	443-681-3792
Safety & Security Officer	443-681-3792
Radiation Safety	443-681-3856
Poison Control	410-706-7701

****For life threatening emergencies dial 911.**

1.0 OFFICE OF LABORATORY SAFETY

1.1 Introduction

In May 1986, the Director of the Laboratories Administration established the full-time position of Safety & Security Officer (SSO) and the Office of Laboratory Safety under the Central Laboratory's Division of Laboratory Licensure, Certification and Training. The Director also approved the establishment of a Laboratory Safety and Security Committee consisting of employees within organization. The Office of Laboratory Safety is currently located within the Division of Administrative Support Services. The SSO position and the Safety Committee were created to allow the organization to:

- 1.1.1 Devote greater attention to health, safety and security issues affecting employees.
- 1.1.2 Implement and maintain a full safety program for employees.
- 1.1.3 Ensure the Laboratories Administration meets all Maryland and Federal Government safety rules, regulations, and standards.

1.2 Safety and Security Committee

1.2.1 Membership

- 1.2.1.1 The Deputy Director of Administrative & Support Services, Safety and Training, Quality Assurance Officer, and Radiation Safety Officer will serve as permanent members of the Committee.
- 1.2.1.2 The SSO will serve as Chairperson and permanent member of both the Committee and all standing subcommittees.
- 1.2.1.3 One or more employees from each floor of the Central Lab will be appointed to the Committee by the SSO and Laboratory Director. Every Division should be represented.
- 1.2.1.4 Members will be recruited by the SSO and/or Director, and appointed with Director's approval.
- 1.2.1.5 All members are expected to serve a minimum of 12 months.
- 1.2.1.6 Full committee meetings will be held bi-monthly, on the first Wednesday of even numbered months.
- 1.2.1.7 Minutes of each full committee meeting will be taken, typed, and distributed to each member. Each member is responsible for updating

their Division Chief. Safety & Security will POST meeting minutes in the Library and on the Laboratory Administration website for all Lab Employees.

1.2.1.8 The SSO, in conjunction with the Director, may establish additional safety subcommittees as necessary.

1.3 Chemical Hygiene Committee (CHC)

1.3.1 Members will be recruited by the SSO, and appointed with the Laboratory Director's approval.

1.3.2 Membership shall consist of five (5) employees that include a Radiation Safety Officer, two (2) senior level Division of Environmental Chemistry employees, and at least two (2) active Safety & Security Committee members.

1.3.3 All members are expected to serve a minimum of 12 months.

1.3.4 Full committee meetings will be held quarterly or as needed.

1.3.5 The CHC is responsible for reviewing, revising, and updating the Chemical Hygiene Plan annually.

1.3.6 The SSO shall be responsible for providing reports to the Safety & Security Committee.

1.4 Standing Subcommittees

1.4.1 Safety Manual Revision/Review Subcommittee – To review, revise, or update the Safety Manual annually.

2.0 EMERGENCY RESPONSE

2.1 Accidents, Injuries, and Illnesses

A laboratory employee who experiences an accident, injury, or medical emergency during work hours, should take the following actions:

- 2.1.1 Immediately assess the situation to determine the severity and danger to other employees.
- 2.1.2 Immediately inform your supervisor and the SSO of the situation. If an accident occurs after hours, follow your Divisional call-in procedure, and inform the SSO as soon as possible.
- 2.1.3 **If the injury or illness is severe (life threatening) or deemed to require immediate emergency medical care:**
 - 2.1.3.1 Call 911 and the security emergency number **443-681-3911**. Give a complete and accurate description concerning the location and the nature of the incident.
 - 2.1.3.2 An employee must stay with the injured or ill person until help arrives.
- 2.1.4 For non-emergency injuries requiring medical attention, follow these procedures:
 - 2.1.4.1 Apply first aid according to the nature of the injury or illness, and take appropriate action to minimize trauma to the injured person.
 - 2.1.4.2 Make arrangements to transport the injured person to the State's designated health care facility [WorkPro and Occupational Medical Services (OMS) locations]. See **Appendix A- First Report of Injury**. The supervisor or SSO should drive the patient to the clinic. If available, use the Administration State vehicle parked at the Ashland Street Garage, 900 N. Washington Street.
 - 2.1.4.3 Get an **AUTHORIZATION FOR EXAMINATION OR TREATMENT** form from a Division Office, the SSO, (**443-681-3792**), the Lab Personnel Officer (**443-681-3939**), or the DHMH Human Resource Lab Liaison (**410-767-5530**). The form must be filled in completely and have the appropriate signatures. See **Appendix A**.
 - 2.1.4.4 The injured person may then be taken to WorkPro and Occupational Medical Services (OMS) location. See **Appendix A** for location and parking information.
 - 2.1.4.5 The employee accompanying the injured individual will not be charged leave. They should, however, clear their absence with the appropriate supervisor.
- 2.1.5 For minor cuts, abrasions, burns etc., apply first aid.

- 2.1.6 In all cases, injuries and accidents must be reported using the proper forms as required by the Laboratories Administration. See Examples in **Appendix A**. Workman's compensation will **not** pay for visits to the WorkPro or Occupational Medical Services (OMS) if a "**First Report of Injury**" form has not been filed. The date of injury must match on all forms. (See the SSO, Laboratory Personnel Liaison, Supervisor, or Division Chief for the necessary forms.)
- 2.1.7 If the injury involves exposure to potentially infectious blood or other body fluids, professional counseling through the designated health care facility should be sought concerning the possibility of contracting a laboratory acquired infection.
- 2.1.8 Provide the supervisor with a brief summary explaining the circumstances of the accident and/or injury, and in filling out all necessary forms. Submit any associated doctor's slips to your supervisor, and bills to the DHMH Human Resource Lab Liaison (**410-767-5530**).

2.2 Chemical Spills

The following procedures should be followed when chemical spills occur. Each Lab space containing a chemical is required to have an updated Lab Room Chemical Inventory and Materials Safety Data Sheet (MSDS)/Safety Data Sheets (SDS) binder corresponding to each chemical inventoried.

- 2.2.1 Know the locations of each eyewash station(s) and safety shower(s) in your work area. Render First Aid: Attend to any person(s) who may be contaminated.
 - 2.2.1.1 If a **liquid spill occurs over a large part of the body**, remove contaminated clothes and quickly shower. Wash off all splatters of chemicals using soap and water. **Do not** use neutralizing chemicals, topical ointments, or salves on the affected area.
 - 2.2.1.2 **If a liquid spill involves the eyes, wash using an eyewash station for a minimum of 15 minutes.** Pull eyelids away from the eye and roll the eyeball up and down, and from side to side to thoroughly wash the eye; seek medical attention.
 - 2.2.1.3 If a dry chemical spill occurs, brush as much of the dry chemical off your clothes and body as possible. Wash your face and hands thoroughly with soap and water. Eyes should be washed as described in **Section 2.2.2.2**. **NOTE:** Sodium hydroxide (NaOH) and potassium hydroxide (KOH) are difficult to wash off skin and clothing, as caustic materials react with oils in the skin, and can penetrate through several

layers. Washing should continue until the soapy (slick) feeling is gone. Seek medical attention if necessary.

2.2.1.4 Some chemicals are corrosive, have volatile vapors, and are very toxic. If a spill occurs, **to avoid exposure**, evacuate the room, close the doors, and wait for the laboratory air circulation system to clear the vapors and dry the spilled solvent. Do not re-enter the laboratory until the Lab Supervisor and Safety & Security Officer have been notified. Any employee entering the laboratory following a spill or lab accident must wear proper personal protective equipment.

2.2.1.5 Give Warnings

2.2.1.6 Evacuate nonessential personnel from the spill area.

2.2.1.7 If the spill material is flammable, turn off all ignition and heat sources.

2.2.1.8 Inform your immediate supervisor and the SSO.

2.2.1.9 Initiate the appropriate cleanup procedure.

2.3 Flammable Solvent Spills

2.3.1 Turn off all gas burners but do NOT turn on or off any electrical equipment. Sparks from electric switches could start a fire.

2.3.2 For minor spills, cover with appropriate spill control material if available, or other appropriate absorbent material, to keep the spill from spreading. Wait until the liquid is absorbed, and place material in a working fume hood to allow the solvent to evaporate.

2.3.3 Large spills may require the assistance of trained personnel and/or equipment to perform an effective and safe cleanup. (Refer to Section 2.2.2.4.)

2.4 Nonflammable Spills

In each given work area, cleanup supplies and equipment on hand should be suitable to deal with a spill, and should be consistent with the potential hazards and quantities of chemicals in the area. Supplies should include neutralizing agents (refer to MSDS/SDSs; e.g., sodium carbonate, sodium bisulfite) and absorbents (e.g., vermiculite, paper towels). Commercial spill cleanup kits containing similar materials and instructions covering their use are recommended, and should be located strategically around technical work areas.

2.4.1 Acid Spills

- 2.4.1.1 Wear rubber gloves and eye protection while pouring the contents of an acid neutralizing spill kit (i.e. baking soda (NaHCO_3), or sodium sulfate (Na_2SO_4)) around the outer edge of the spill to neutralize the acid. Continue to add dry neutralizing material to the remainder of the spill area until the liquid has been absorbed.
- 2.4.1.2 Wait 10-15 minutes, or until chemical neutralization is complete. Wear protective gloves and use a dustpan to pick up as much “mud” or waste as practical. Put the “mud” in a plastic container for proper disposal.
- 2.4.1.3 While wearing gloves, use paper towels to clean up the remaining mud and liquid. A wet mop or wet towels may then be used to wash the surfaces. All towels should be placed in a plastic container for proper disposal. (Refer to Section 2.2.2.4).

2.4.2 Alkali Spills

- 2.4.2.1 Wear protective gloves and eye protection while pouring dry absorbent material around the outer edge of the spill. Continue to add the dry neutralizing material to the spill area until the liquid has been absorbed. The contents of a base neutralization kit, paper towels, or vermiculite may be used to absorb the liquid. **NOTE: DO NOT** add acids to concentrated or strong caustic spills. There may be violent chemical reactions, causing the spill to spread to a wider area.
- 2.4.2.2 When the liquid has been absorbed, scoop up the absorbing material, and rinse well with water before placing in a proper disposal container. **NOTE:** Caustics are difficult to wash out of absorbents, so continue the washing for several minutes.
- 2.4.2.3 After the spilled liquid and absorbents have been removed, pour small amounts of dilute acetic (2-3%) or 1% hydrochloric acid on the spill area. Allow neutralization to be completed. While still wearing protective gloves and eye protection, mop or wipe up the liquid. Rinse the area again and wipe with a wet mop or towels. Cleanup materials should be disposed of in a plastic container (Refer to Section 2.2.2.4).

2.5 Radioactive Injuries and Spills

2.5.1 Radiation Accident Involving Injury

- 2.5.1.1 Notify the Radiation Safety Officer (RSO) immediately (443-681-3856) concerning injuries or spills.

- 2.5.1.2 Restrict access to the area. Provide necessary first aid and notify appropriate emergency personnel using phone numbers found at the front of this manual.
- 2.5.1.3 If the person is contaminated and must be transported out of the area for medical attention, remove contaminated clothing and thoroughly wash skin surface with soap and water with a scrub brush.
- 2.5.1.4 If decontamination is not possible, wrap the person in a blanket to minimize contamination spread. At the medical facility, instruct medical personnel of the need for contamination control and radiation surveillance.
- 2.5.1.5 If the injury does not require immediate medical care, have the person remove contaminated clothing and wash the affected skin surfaces with water, followed by mild soap and water. Survey contaminated skin surfaces after each washing until contamination is reduced to less than 100 dpm/100 cm². (More extensive skin and area decontamination procedures are outlined in the Safe Handling of Radioactive Materials Handbook 92 and Guide to Safe Handling of Radioactive Material (*Perkin-Elmer*). Both pieces of literature are found in the Radiation Laboratory. Contact the RSO.)
- 2.5.1.6 Assess the radiation dose, both external and internal (urine assay, thyroid count), received by personnel involved in the accident. Maintain appropriate records.

2.5.2 Spills Involving Radioactive Materials

In the event of a major spill of radioactive materials, use the following procedures:

- 2.5.2.1 Notify all personnel not involved in the spill to vacate the room immediately.
- 2.5.2.2 Restrict access to the spill area and instruct those possibly contaminated to remain in the lab. Affected employees must be surveyed. Employees must remove contaminated clothing and wash affected skin surfaces.
- 2.5.2.3 If in the presence of airborne contaminants, put on protective clothing, lab coat, disposable gloves, shoe covers or disposable plastic boots, and respirator. Confine the spill with absorbent material or pads.
- 2.5.2.4 Notify the RSO and immediate supervisor to request assistance.

- 2.5.2.5 Monitor personnel for contamination and decontaminate as needed before they leave the laboratory (or shower).
- 2.5.2.6 Proceed with spill cleanup under appropriate supervision while using proper protective equipment.
- 2.5.2.7 Begin decontamination efforts from the perimeter (low activity) of the spill, and proceed toward the center of the spill (higher activity).
- 2.5.2.8 Use water, soap, cleansers, and absorbent cleaning pads to decontaminate the area.
- 2.5.2.9 Survey the area again, and continue decontamination until levels are reduced to acceptable limits (250 dpm/100 cm² for most beta and gamma emitters).
- 2.5.2.10 Place decontamination materials in the appropriate waste container for proper disposal.

2.6 Biohazard Spills

2.6.1 Spills in a Biological Safety Cabinet

- 2.6.1.1 Cleanup should begin immediately using a suitable disinfectant. A germicidal disinfectant such as a 0.04 % solution LopHene or a fresh 1:10 dilution of sodium hypochlorite (household bleach) should be used in wiping down all accessible cabinet surfaces.
- 2.6.1.2 Allow at least 30 minutes of contact time with the germicide before removing items from the cabinet. NOTE: spills that contain organic material, such as blood or feces, will interfere with the microbicidal activity of many agents by acting as a physical barrier. As a result, these spills may require preliminary wiping in order to reduce the organic load prior to disinfection.
- 2.6.1.3 If the cabinet includes a catch basin beneath the work surface, it should be flooded with an appropriate disinfectant for at least 30 minutes, and then flushed with water to remove any residual disinfectant, thereby preventing corrosion of surfaces. Alcohol should not be used due to the explosive potential of large quantities.
- 2.6.1.4 If the spill overflows into the interior of the cabinet, inform the immediate supervisor and the SSO. This requires a Biological Safety Cabinet certification technician to perform the decontamination.

2.6.1.5 All items within the cabinet should be placed in autoclave cans for transport to the autoclave. Items that cannot be autoclaved, such as viable cultures to be retained, should be wiped carefully with the disinfectant.

2.6.1.6 The operator's gloves and gown or lab coat should be considered contaminated, and be autoclaved after the cleanup process is completed.

2.6.1.7 Run the cabinet for 15 minutes after cleanup is completed, and before routine use is resumed.

2.6.2 Spills in a Laboratory

2.6.2.1 If a major spill occurs in a laboratory under negative pressure, warn employees in other rooms immediately to leave as quickly as possible. Allow 30 minutes for any aerosol resulting from the spill to settle before cleanup begins.

2.6.2.1.1 For spills in Biosafety Level 3 labs refer to the Biosafety Level 3-Standard Operating Procedure.

2.6.2.2 If a spill occurs in an area working with Select Agents, inform the immediate supervisor, the SSO (**443-681-3792**), the Principle Investigator(s) (PI), and the Responsible Official (RO).

2.6.2.3 The employee involved in the spill should remove and place their contaminated clothing in a biohazard bag for autoclaving.

2.6.2.4 Allow the aerosol to settle for 30 minutes, and determine the extent of the spill area. All objects within the spill area must be disinfected or sterilized. See **NOTE** in Section 2.6.1.4.

2.6.2.5 Cover spilled and/or broken culture tubes, plates, and other involved materials with paper towels; flood the towels with a fresh 1:10 household bleach dilution or other appropriate disinfectant.

2.6.2.6 Allow the flooded towels and materials soak a minimum of 30 minutes.

2.6.2.7 Wearing heavy, puncture-resistant protective gloves, pick up the spilled or broken materials, and deposit them into an autoclave can or sharps container. (Label bag: "Broken Glass" to protect waste bag handlers). Avoid handling broken material directly by using a stiff piece cardboard to maneuver material onto a larger piece of cardboard.

2.6.2.8 Flood the spill area with additional disinfectant and/or wipe down the area with new paper towels soaked with disinfectant. Use mops that can be disinfected with 10% bleach.

2.6.2.9 Disinfect reusable rubber gloves by soaking overnight in a 1:10 dilution (10%) of household bleach. Be sure gloves treated in this manner are rinsed of all bleach before reusing, so hands do not suffer bleach burns. Avoid reusing cleaning materials. When possible, use disposable materials.

2.6.3 Spills Outside the Laboratory

2.6.3.1 If a biologically hazardous material is spilled during transport outside a laboratory, the spill must be contained in a Bio-Transport Container. Follow manufacturer's guidelines for cleanup.

2.6.3.2 Inform the immediate supervisor and the SSO (**443-681-3792**). If the spill occurs in an area working with Select Agents, inform the PI, and the RO.

2.6.3.3 Follow steps outlined in Section 2.6.2 entitled "Spills in a Laboratory".

2.6.4 Spills Involving Biohazards and Radioactive Materials

2.6.4.1 If a radioactive biohazardous material is spilled, immediately warn others to leave the area. **BEFORE** initiating any decontamination procedures, consult the RSO (**443-681-3856**) and the SSO (**443-681-3792**). Routine disinfecting procedures may need modification when dealing with radioisotopes.

2.6.4.2 The RSO must evaluate the potential hazard of radioactivity release before a steam autoclave can be used. The most likely radiation hazard in a microbiological laboratory will be either ^{14}C or ^3H , and typically either can be autoclaved without hazard. However, the radioactivity of ^{125}I may be sufficient to preclude autoclaving. In such a case, the bio-hazardous agent may need to be inactivated using a compatible liquid chemical germicide before being packaged as a radioactive waste. **DO NOT USE** household bleach (sodium hypochlorite) as the liquid germicide. I_2 could be released through the chemical reaction. Use an appropriate radiological decontaminant.

2.6.5 Spills in a Centrifuge

Aerosol containment devices must be used when centrifuging biohazardous material. (Cleanup methods will be contaminant/agent specific.)

2.6.5.1 If a tube breaks or spills in a centrifuge, the rotor lid must remain closed for a minimum of 30 minutes to allow fine droplets to settle. The bucket containing the spilled specimen should be placed carefully in a pan containing disinfectant.

2.6.5.2 The surfaces of the centrifuge head, bowl, trunnions and remaining buckets should be swabbed with an appropriate disinfectant. The trunnions and buckets may also be autoclaved. Sealed rotor buckets are removed and disinfected in a biological safety cabinet. (See manufacturer's instructions).

2.6.6 Spill Requiring Gross Decontamination

2.6.6.1 If a major spill occurs in a laboratory under negative pressure, warn employees in other rooms immediately to leave as quickly as possible. Allow 30 minutes for any aerosol resulting from the spill to settle before cleanup begins.

2.6.6.2 Inform the immediate supervisor, the SSO (**443-681-3792**), PI, and the RO.

2.6.6.3 The worker involved in the spill should remove contaminated clothing and place in a biohazard bag for autoclaving.

2.6.6.4 Allow the aerosol to settle for 30 minutes. Determine the extent of the spill area. All objects within the spill area must be disinfected or sterilized. See **NOTE** in Section 2.6.1.4.

2.6.6.5 If the spill occurs in a Biosafety Level-3 laboratory, follow "Biosafety Level 3-Standard Operating Procedure," Appendix E.

2.7 Managing Exposure Following Accidents Involving Infectious Agents

Immediately following known exposure, no emergency procedure can be wholly relied upon to prevent infection. First aid after exposure should consist of the following steps.

2.7.1 Remove or dilute the infectious material (e.g., contaminated clothing) and institute first aid measures (e.g., cleaning minor wounds with soap and water, washing eyes for 15-20 minutes).

2.7.2 Contact the supervisor or Division Chief and the SSO to help assess infection risk.

- 2.7.3 Complete the “First Report of Injury” form. Refer the exposed person to the State’s designated healthcare facility or to his/her private physician for treatment and/or evaluation for prophylaxis (disease prevention).
- 2.7.4 The body fluid (blood, serum, etc.) involved in the accident must be saved for further testing, or a blood sample from the source of exposure should be obtained for testing.
- 2.7.5 Risk assessment by laboratory staff should include an evaluation of the individual and/or population source of the specimen, the type and amount of infectious material, the mode of transmission, the portal of entry, and the general and specific conditions of the person exposed.
- 2.7.6 Prophylactic measures should be applied **ONLY** under the direction of a physician and may include local therapy such as instillation of antiseptic or antibiotic eye drops, administration of specific or nonspecific immunoglobulin, vaccination (e.g., tetanus or HBV in a non-immunized person), serological screening, or prescribing of specific antibiotics.
- 2.7.7 Cuts, punctures and abrasions (percutaneous exposures) involving blood or other body fluids (i.e. amniotic, pericardial, peritoneal, pleural, synovial and cerebrospinal fluids, semen, vaginal secretions or other fluids visibly contaminated with blood) should be referred to a physician for prophylaxis evaluation. Once exposure has occurred, a blood sample should be drawn from the affected employee (after consent is obtained) and tested for hepatitis B surface antigen (HBsAg) and antibody to human immuno-deficiency virus (HIV). It is extremely important that all individuals who seek consultation for any HIV-related concerns receive counseling as outlined in “Updated U.S. Public Health Service Guidelines for the Management of Occupational Exposures to HIV and Recommendations for Postexposure Prophylaxis” (MMWR, September 30, 2005 / 54(RR09); 1-17).
- 2.7.8 **Hepatitis B post exposure management** - Options to receive vaccination and/or treatment can be determined by the employee and his/her physician. For exposure to a source specimen positive for HBsAg, the exposed individual who has not received the hepatitis B vaccine should be vaccinated. A single dose of hepatitis B immune globulin (HBIG) is also recommended as soon as possible after the exposure. (Its value beyond 7 days after exposure is unclear). The exposed individual should also be tested for antibody to hepatitis B surface antigen (anti-HBs), and given one dose of the vaccine and one dose of HBIG if the antibody level in the person's blood is inadequate (i.e. <10 SRU by RIA, negative by EIA). If the exposure source cannot be identified, an unvaccinated, exposed individual should receive the vaccine series.

- 2.7.9 **Human immuno-deficiency virus (HIV) post exposure management** - For any exposure to a source individual who has AIDS, who is found to be positive for HIV infection, or who refuses testing, the exposed person should be counseled regarding the risk of infection and evaluated clinically and serologically for evidence of HIV infection as soon as possible. The employee should be advised to report and seek medical evaluation for any acute febrile illness that occurs within 12 weeks following exposure. Following the initial serological test at the time of exposure, sero-negative individuals should be retested 6 weeks, 12 weeks, and 6 months after the exposure to determine whether transmission has occurred. During this follow-up period (specifically the first 6-12 weeks after exposure when most infected persons seroconvert) exposed individuals should follow "Updated U.S. Public Health Service Guidelines for the Management of Occupational Exposures to HIV and Recommendations for Postexposure Prophylaxis" (MMWR, September 30, 2005 / 54(RR09); 1-17). These include refraining from blood donation and using appropriate protection during sexual intercourse. If the source individual/specimen was tested and found to be seronegative, baseline testing of the exposed employee with follow-up testing 12 weeks after may be performed if desired by the employee or recommended by the healthcare provider.
- 2.7.10 A baseline serum sample should be obtained at the time of occurrence in cases where exposure involves microorganisms for which serological tests are available (e.g., HIV, *Brucella*).
- 2.7.11 The immediate supervisor must oversee reporting of all accidents and exposures within 1 working day (as outlined in Section 1.1 in this manual).

2.8 Fire Prevention and Control

All employees must familiarize themselves with emergency procedures in case of fire, and how to prevent fires.

- 2.8.1 Sound the alarm to initiate evacuation of the building. If the fire alarm has not activated automatically, activate at the nearest "pull box."
- 2.8.2 Contact the Security Desk by dialing **(443-681-3795)**.
- 2.8.3 Give your name and location (e.g., John Doe, floor, and the room number).
- 2.8.4 **DO NOT HANG UP** until you are certain the message has been accurately received! In regional laboratories, if you can do so safely, contact the local fire department by dialing 911.
- 2.8.5 Give your name and location (e.g., This is _____. I am reporting a fire on the ____ floor of the _____ building, located at _____.)

DO NOT HANG UP until you are certain the message has been accurately received.

- 2.8.6 Evaluate the type and extent of the fire. If it has spread rapidly, or in danger of spreading rapidly, **GET OUT**. Control measures should be attempted only on small isolated fires, and only if you have received proper training (i.e., if you have received fire-fighting training) and have proper extinguishing equipment. Otherwise, take only those measures you can accomplish safely to confine the fire, such as closing doors.
- 2.8.7 Do not fight a fire unless all of the following criteria are met:
 - 2.8.7.1 The fire has been reported and the alarm activated.
 - 2.8.7.2 Everyone else has evacuated the area.
 - 2.8.7.3 The fire is small and is confined to its immediate area of origin (e.g., wastebasket, hood, or small piece of equipment).
 - 2.8.7.4 You have an exit plan, and can fight the fire with your back to said exit.
 - 2.8.7.5 You have extinguishing equipment in good working order, know how to properly use it.
 - 2.8.7.6 You won't hesitate to evacuate if your effort is failing.
- 2.8.8 In a laboratory, smoke and toxic vapor inhalation and explosions pose a greater threat than burns from a fire. Your primary responsibility is to sound the alarm and evacuate people out of the area.
- 2.8.9 **In a fire, do not crawl on the floor!** Look for the air space between the vapors and the smoke. Flammable vapors are generally heavier than air and collect near the floor level.
- 2.8.10 In cases when a you or co-workers clothes catch on fire the following procedures should be followed:
 - 2.8.10.1 If you are on fire **STOP, DROP, and ROLL** covering your face. Call out for help. Do not run or flap your arms this action can fan the fire making it worse.
 - 2.8.10.1.1 In cases of minor burns apply water and first aid, and seek medical attention.
 - 2.8.10.2 If a co-workers clothes catch fire:

- 2.8.10.2.1 Tell the victim to STOP, DROP, and ROLL covering his/her face.
 - 2.8.10.2.2 Prevent the victim from running or fanning their arms.
 - 2.8.10.2.3 Retrieve a fire extinguisher or call out for another co-worker to a fire extinguisher.
 - 2.8.10.2.4 Use the fire extinguisher hose and directly spray the victim. Once the fire is out evaluate the injury.
 - 2.8.10.2.5 In cases of minor burns apply water and first aid, inform supervisor and SSO, and seek treatment. If the injury is serious and/or life threatening, call 911.
- 2.8.11 Fire prevention is important in avoiding fire emergencies. Observing the following suggestions will help prevent fires and minimize their spread and resulting damage.
- 2.8.11.1 Identify the location and characteristics of all flammable, combustible, and/or explosive materials in your laboratory.
 - 2.8.11.2 Smoking is prohibited in the building. Never allow an open flame in any area where combustible liquids are present.
 - 2.8.11.3 Always dispose of flammable liquids properly. See Section 9.0.
 - 2.8.11.4 Detection of a "solvent" odor may indicate a potentially dangerous situation. Report solvent odors to your supervisor or the SSO.
 - 2.8.11.5 Be aware of water reactive chemicals and strong oxidizing materials. In the presence of organic material, self-igniting explosions and fires are possible. See **Appendix B**.
 - 2.8.11.6 Be cautious when using oxygen from compressed gas cylinders. Oxygen can combine with combustible materials and ignite.
 - 2.8.11.7 Before leaving the laboratory unattended, extinguish all flames. Use only flint igniters to light burner flames.
 - 2.8.11.8 Unplug all coffeepots and shut down all appropriate laboratory equipment at the end of each workday.

2.9 Electrical Burns, Shocks, and Accidents

Electricity is one of the most potentially dangerous commodities in our society. Either electric current or its arc causes electrical burns.

- 2.9.1 Electrical Arcs - Contact with a high voltage current may be associated with an arc or flash of light. The temperature of the associated ionized particles and the immediate surrounding gases of the arc can be extremely high. Circumscribed burns occur where portions of the arc contact the victim. Arc burns may be complicated by a flame burn if the arc ignites the victim's clothing.
- 2.9.2 Electrical Current - When a person's hands come in contact with an electric current greater than 15 mA for men, or 10 mA for women, the person cannot release his grasp of the conductor, and is said to "freeze" to the circuit despite struggles to free themselves.
- 2.9.3 In the event of an accident, the electric current should be switched off immediately using the emergency cut off switch. If this is not possible, the rescuer must separate the victim from the contact, using a long piece of wood, broom handle, rope, or other nonconductive object. **NOTE: Disposable rubber gloves do not provide adequate insulation and the rescuer must be certain he or she is standing on a dry nonconductive surface.**
- 2.9.4 After interrupting the current, the rescuer should check the victim's breathing and pulse and if necessary, and initiate CPR. High alternating currents flowing across the chest are sufficient to cause contraction of the chest muscles, which halts breathing.

2.10 Leaking Compressed Gas Cylinders

Occasionally a cylinder or one of its component parts develops a leak. Most leaks occur at the top of the cylinder in areas such as the valve, threads, valve safety devices, valve stem, or valve outlet. If you suspect a leak, **NEVER** use a flame to detect it. Use a gas leak detector, such as "snoop" or soapy water. **NEVER** attempt to repair a leak at the valve threads or safety device. The following general procedures should be used for leaks without serious exposure of personnel.

- 2.10.1 If it is necessary to move a leaking cylinder through populated portions of the building, place a plastic bag, rubber shroud, or similar device over the top of the cylinder, and secure with duct tape to confine the leaking gas.
- 2.10.2 Transport the leaking cylinder to an isolated area (away from combustible material if the gas is flammable or an oxidizing agent) and post signs that describe the hazards.
- 2.10.3 Corrosive gases may increase the size of the leak as they are released; and some corrosives are also oxidants or flammable. Move the cylinder to an

isolated, well-ventilated area and consult the vendor. Post signs that describe the hazards.

2.10.4 Toxic Gases - Follow the same procedure for corrosive gases outlined in Section 2.10.3.

2.10.5 More Serious Hazards - When the nature of the leaking gas constitutes a more serious hazard, self-contained breathing apparatus, special protective apparel, or both, may be required. Basic action for large uncontrolled leaks may include any of following steps:

2.10.5.1 Sound the alarm and evacuate personnel.

2.10.5.2 If safe to do so, rescue injured personnel. Otherwise, wait for an appropriately equipped rescue crew.

2.10.5.3 Inform the SSO of any emergency rescue or firefighting needs.

2.11 Safety Showers and Eye Wash Stations

2.11.1 Safety showers should be used for immediate first aid treatment of chemical splashes. Every laboratory employee should familiarize themselves with the locations of and proper operation of the safety showers in the work area. Call for help, if necessary. Safety showers must be tested routinely by the laboratory SSO to ensure all valves are operable, and to flush any debris from the system.

2.11.2 Eyewash drench hoses provide a soft stream or spray of aerated water for an extended period (15 minutes). Eyewash drench hoses should be tested and cleaned weekly by designated laboratory personnel. Portable/disposable eye wash stations are a suitable alternative for areas where a fixed eye wash fountain is not readily available. (Refer Emergency Eyewash Equipment Instructions and Checklist, Appendix C.)

3.0 GENERAL SAFETY POLICIES

3.1 Visitor Access

3.1.1 Visitors (i.e., anyone who does not have assigned duties or responsibilities in these areas) are limited to those who have obtained permission of the supervisor. See Laboratories Administration Security Plan and Manual.

3.1.2 Children and Minors - Children (under 18 years of age) are prohibited from entering technical work areas. When in the Central Lab, children are

restricted to offices, administrative areas, conference rooms, and rest rooms. An adult must be present at all times.

3.2 Smoking, Eating, and Drinking Policy

3.2.1 Smoking is prohibited in all State buildings. Smoking is allowed only in designated areas outside the building.

3.2.2 **Eating, drinking, applying cosmetics and storing food in laboratory work areas is prohibited. Eating, drinking, and food storage is allowed only in designated areas and refrigerators.**

3.2.3 **Mouth Pipetting is Strictly Forbidden.** Safety pipetting devices must be procured and routinely used.

3.3 Medical conditions notification

3.3.1 Medication (e.g., heart conditions, diabetes, allergies, and pregnancy) and the taking of medications (especially Narcotic-opiate based pain meds, depressants, immuno-suppressants and relaxants) which may affect your job performance and safety should be immediately reported to your supervisor and the SSO.

3.4 Personal Safety Precautions

Personal safety precautions must be taken when dealing with hair, beards, and glasses and contact lenses in the laboratory.

3.4.1 Hair should be secured behind the shoulders to prevent it from coming into contact with hazardous materials and contaminated surfaces, and to prevent shedding of microorganisms into the work area. Restraining hair appropriately will help keep it out of machinery with moving parts, such as a centrifuge.

3.4.2 Bearded men must observe the same precautions. Long beards in a laboratory setting pose a potential danger around equipment with moving parts. All beards are a potential source of contamination. Beards are prohibited while using respirators. Employee with beards must wear a Powered Air Purifying Respirator (PAPR).

3.4.3 Glasses and contact lenses are not an acceptable alternative to safety goggles/glasses.

3.5 Personnel Protective Equipment (PPE)

All laboratory personnel must minimize the risk of exposure to specimens that may contain bloodborne pathogens, infectious agents, and toxic chemicals and environmental samples which could be potentially harmful to humans (29 CFR 1910.132, Personal Protection Equipment). Every Laboratories Administration employee is responsible for strictly adhering to all administration policies governing PPE.

All Laboratories Administration employees are required to wear eye protection and lab coats upon entering ALL lab areas. Gloves are required for task specific activities, refer lab unit SOP and manufacturer guidelines.

BSL-3 labs require additional PPE (see section 3.7.7, 7.4.2, and BSL-3 SOP) and training. Laboratories Administration employees working in BSL-3 labs must participate in annual BSL-3 and respirator/PARP training. Only fully trained employees receive the BSL-3 SOP.

3.5.1 Gloves

3.5.1.1 Disposable gloves must be worn by all employees engaged in handling, processing or testing human or animal specimens consisting of, or containing, tissue, blood, serum, plasma, urine, cerebrospinal fluid, or other body fluids. Gloves must be worn when handling toxic, carcinogenic or other potentially harmful chemicals and environmental samples.

3.5.1.2 Gloves are task specific. When working with chemicals, supervisors and employees must adhere to glove manufacturer recommendations.

3.5.1.2.1 When determining the type of glove to use supervisors should base their discussion on task required, chemical or material being handled, MSDS/SDS, frequency and duration of the chemical or material being handled, and the method used to handle the chemical or material--direct or indirect contact, and a risk assessment.

3.5.1.2.2 Incidental contact (little or no direct contact with the chemical or hazardous material) includes but not limited to these examples:

3.5.1.2.2.1 Accidental drips, splashes, or spills.

- 3.5.1.2.2.2 Accidental overspray from a dispensing device.
- 3.5.1.2.2.3 Handling infectious agents that require barrier protection.
- 3.5.1.2.2.4 To prevent contamination of materials during handling.
- 3.5.1.2.3 Extended contact includes but not limited to these examples:
 - 3.5.1.2.3.1 Handling highly contaminated materials.
 - 3.5.1.2.3.2 Submerging hand in chemical or other hazardous substance.
 - 3.5.1.2.3.3 Need for physical protection from temperature extremes or sharp/piercing objects.
- 3.5.1.3 Gloves should be changed frequently and immediately if they become visibly or potentially contaminated.
- 3.5.1.4 Remove contaminated gloves and wash hands immediately.
- 3.5.1.5 All contaminated gloves must be disposed of using the same methods required for the disposal of infectious waste or toxic samples.
- 3.5.1.6 Remove gloves and wash hands before exiting any lab area.
- 3.5.1.7 Gloves are strictly prohibited in public areas and in passenger elevators.
- 3.5.1.8 Gloves are not permitted when performing computer analysis in write-up areas.
- 3.5.1.9 Gloves are required PPE when handling and transporting specimens/samples and/or Bio Transport Carries/bins throughout 1770. However, “clean” areas such as elevator buttons and clean door knobs should only be touched with an ungloved, clean hand or a clean barrier.
- 3.5.2 Lab Coats (including disposable lab coats, gowns, or aprons)
 - 3.5.2.1 **All employees working in any lab area must wear lab coats or gowns.**
 - 3.5.2.2 Lab coat or gown must be when handling and transporting specimens/samples and/or Bio Transport Carries/bins throughout 1770.

3.5.2.3 Lab coats may not be worn in public areas (such as offices, lunch areas, conference rooms, passenger elevators, break rooms, and restrooms).

3.5.2.4 Aprons do not provide acceptable protection to arms and shoulders and may not be worn in place of coats or gowns.

3.5.3 Eye and Face Protection

3.5.3.1 Employees are required to wear safety glasses in all lab areas.

3.5.3.2 Face protection (i.e., full face shield) must be worn if splashing or spraying of mucous membranes with blood, other body fluids or caustic chemicals is possible (e.g., removing stoppers from racks of Vacutainer tubes or pouring quantities of strong acids).

3.5.4 Respirators and PAPRs

3.5.4.1 The Laboratories Administration has a mandatory Respirator Protection Policy in place. All employees in this program will receive an annual medical evaluation, and participate in an annual respirator fit test and PAPR training (See current Respiratory Protection Policy).

3.5.4.2 BSL-3 Suites and Select Agent Rooms 1E1 and 1E3 RM, (201 W. Preston St. Facility), require employees to wear a N95 respirator or PAPR at all times.

3.5.5 Shoes should be comfortable and cover the entire foot. **Shoes with open toes or heels are prohibited in lab areas.** (See Employee Handbook).

3.5.6 Protective bandages must cover all skin wounds (e.g., cuts, abrasions, “weeping” lesions, and areas of dermatitis) on exposed skin surfaces before an employee handles potentially infectious specimens or toxic samples/materials. Bandages on the hands must fit under disposable gloves. Orthopedic boots must be covered with disposable booties in technical areas.

3.5.7 Required PPE for BSL-3 Suites:

3.5.7.1 Required PPE: Gloves (nitrile and/or latex), booties, Tyvek coveralls/suit, apron, sleeve covers, bouffants, safety glasses, N95 respirator, and PAPRs. (For highly infectious agents with a high risk of morbidity and/or mortality additional PPE, i.e., dissection gown, will be required.)

3.5.7.2 Refer to the current BSL-3 SOP for the proper gowning (donning) and de-gowning (doffing) procedure.

3.6 Hand Washing

Hand washing is the most effective means by which employees can protect themselves from lab-acquired infections and chemical poisonings. Hand contamination by microorganisms and toxic substances can readily occur during handling and manipulation of specimens, samples, equipment and supplies, and during contact with work surfaces. Hand washing is necessary for all employees working in any technical area, after removing disposable gloves, after leaving the work area for any reason and before eating, drinking, or applying cosmetics.

3.6.1 Soap is an emulsifying agent, not a disinfectant. Its purpose is not to kill microorganisms, but to spread across a wet surface, such as wet skin, and loosen microorganisms so they can be rinsed away.

3.6.2 Effective hand washing includes the following steps:

3.6.2.1 Turn on faucets and wet hands. (Soap added to dry hands greatly reduces its emulsifying ability to spread over the surface of the hands).

3.6.2.2 Dispense and/or rub soap into a cupped hand and spread over both hands and between fingers. If needed, add more water to facilitate spread and lathering.

3.6.2.3 Wash for 30 seconds by vigorously rubbing both sides of hands, starting from several inches above the wrist and extending downward between the fingers, and around and under the fingernails.

3.6.2.4 Rinse thoroughly under running water. Rinsing should start above the wrist area and proceed to the tips of the fingers. **NOTE:** If faucets are not hands-free (knee or foot-operated), do not turn off water, and don't touch faucet handles!

3.6.2.5 Dry hands thoroughly with paper towels. If faucets are hand-operated, turn off using a dry paper towel to protect the clean hand.

3.7 Phlebotomy

3.7.1 All patients/donors will be regarded as potentially infectious.

3.7.2 A lab coat must be worn when drawing blood.

3.7.3 Protective gloves must be worn when drawing blood (polyethylene gloves provide good sensitivity). Gloves must be changed after each patient. Phlebotomists must wash hands between each change of gloves, even if gloves are intact and do not appear to have been contaminated with blood or other body fluids.

- 3.7.4 Vacuum tubes may only be filled using their internal vacuum. Never force blood into an evacuated tube by exerting pressure on the syringe plunger.
- 3.7.5 Place all materials used to draw blood or stop bleeding in a biohazard container (or Sharps container) for proper disposal. NEVER fill container more than $\frac{3}{4}$ full.
- 3.7.6 Phlebotomy may only be performed in Rm 100E.
- 3.8 Glassware
 - 3.8.1 Inspect all glassware prior to use for chips, cracks and stresses. Avoid using chipped, cracked or broken glassware. If it cannot be repaired, discard all chipped, broken or cracked glassware into a glass discard box or other designated glass disposal container.
 - 3.8.2 Before washing or discarding, decontaminate all glassware exposed to toxic or potentially infectious specimens or agents, according to your approved SOP.
 - 3.8.3 Broken or discarded glass and glassware should be disposed of in a manner that poses no hazard to the custodial staff.
 - 3.8.4 Always use safety tongs or heat-resistant gloves when handling hot glassware.
 - 3.8.5 Do not leave pipettes sticking out of bottles, flasks, beakers or other containers.
 - 3.8.6 Plasticware should be substituted for glassware wherever possible.
- 3.9 Centrifuging
 - 3.9.1 Balance all pairs of tubes before initiating centrifugation.
 - 3.9.2 Flammable liquids and hazardous or infectious samples/specimens should be plugged or capped when centrifuged. Contaminated items can cause infectious aerosols; and flammable liquids can become bombs.
 - 3.9.3 **NEVER** overfill centrifuge tubes, especially when placed in angle-head centrifuges. This will prevent the liquid from coming in contact with the lip of the tube after being placed in the rotor.
 - 3.9.4 Centrifugation involving any infectious agents may only be performed in centrifuges possessing sealed heads or centrifuge safety cups. Such heads or cups must be opened only in a biological safety cabinet.

- 3.9.5 Never operate a centrifuge unless the cover is closed.
- 3.9.6 Keep hair, beards, neckties, ID-badge chains and other dangling items out of the way.
- 3.9.7 Do not open centrifuge covers until the centrifuge has come to a complete stop.
- 3.9.8 Microhematocrit centrifuges must be cleaned daily with an appropriate disinfectant.
- 3.9.9 Centrifugation of materials containing volatile, flammable solvents must be performed only in centrifuges designed for that purpose.
- 3.9.10 Bowls, lids, and buckets should be cleaned routinely and whenever there is visible evidence of contamination.
- 3.9.11 The primary operator must disinfect any centrifuge before being serviced by technicians or returned to the manufacturer for repair.
- 3.9.12 Routine Equipment Maintenance
 - 3.9.12.1 Routine scientific equipment maintenance is the responsibility of the user. It is the operator's job to keep equipment clean, operating safely and effectively, and routinely inspected and maintained. Users are also required to inform the lab's supervisor and manufacturer when equipment malfunctions and to decontaminate any equipment prior to being worked on in the laboratory, or removed from the laboratory for repair or disposal.
 - 3.9.12.2 Laboratory equipment should be routinely decontaminated, as well as, after spills, splashes, or other potential contamination.
 - 3.9.12.3 Spills involving infectious materials must be contained, decontaminated, and cleaned by staff properly trained and equipped to work with infectious material.
 - 3.9.12.4 Equipment must be decontaminated before repair, maintenance, or removal from the lab.
 - 3.9.12.5 Supervisors are responsible for seeing that all equipment under their control is routinely cleaned and maintained by: section personnel (e.g., wiping dust from UV lights; defrosting and/or cleaning refrigerators and freezers and water baths; cleaning microscopes; maintaining temperature records; running autoclave/sterilizer controls; balancing tubes before centrifuging).

- 3.9.12.6 Determination of airflow rates in chemical fume hoods and biological safety cabinets, radiation source records, and safety inspections, in conjunction with the SSO.
- 3.9.12.7 Ensure preventive maintenance is performed to equipment following manufacturer's guidelines. Preventive maintenance should be performed by service technicians (e.g., recalibrations, performance qualification testing or operational qualification testing).
- 3.9.12.8 Surfaces of instruments must be cleaned routinely and whenever there is visible specimen or chemical contamination.

3.9.13 Photocopy machine toners, inks and other fluids may be toxic. Operators should wear gloves when working with or replacing these cartridges.

3.9.14 Biological Safety Cabinets (BSC)

- 3.9.14.1 BSC must be disinfected at the end of use (or at the end of each day of use) using the appropriate disinfectant, according to the lab's SOP. Class I or II BSCs must be tested and certified annually, whenever one is moved.

3.9.15 Chemical Fume Hoods

- 3.9.15.1 Chemical fume hoods should be kept clean and uncluttered. All surfaces should be cleaned periodically using appropriate protective gear and cleaning agents. Spills must be cleaned up promptly, observing all due precautions. The user should ascertain there is sufficient air exhausting from the cabinet.
- 3.9.15.2 A disinfectant must be added to water in a water bath to prevent potential contamination with both pathogenic and nonpathogenic microorganisms. Use 0.5% StaphineTM or a suitable alternative in warm water baths, and a solution of 70% propylene glycol in cold water baths.

3.10 Good Housekeeping

- 3.10.1 Exits, doorways, aisles, safety showers, eyewash stations and fire extinguishers must not be obstructed in any way. No equipment, furniture, supplies or trash is permitted in exit routes or areas. **Any materials stored on top of bookshelves or shelving units must be 12 inches from the ceiling.**

3.10.2 All windows must be kept uncovered. Nothing may be hung or taped to glass

(e.g., pictures, posters, blinds, or curtains) Refer to Laboratories Administration Tenant Guidelines.

- 3.10.3 Doors connecting labs and hallways must be kept closed to assure negative air pressure in the laboratories.
- 3.10.4 Workbenches, countertops, chemical fume hoods, and BSC must be kept free of unnecessary clutter. These should be disinfected as necessary throughout the day, and at the end of each workday.
- 3.10.5 Keep excess supplies in storage, not in work areas.
- 3.10.6 Proper disposal methods and SOPs must be followed for all glass waste, infectious waste, chemical waste, needles and syringes, and radioactive waste.
- 3.10.7 For additional housekeeping all employee shall reference the Laboratories Administration Tenant Guidelines.

3.11 Identification Badge Policy (Refer to Security Plan & Manual)

- 3.11.1 During orientation, all new 1770 Central Lab employees will be issued a Laboratories Administration photo ID keycard.
- 3.11.2 The Laboratories Administration photo ID keycard must be visibly worn at all times, in all areas of the 1770 Central Lab.
- 3.11.3 All Laboratories Administration employees must be in possession of their Official State of Maryland photo ID badge at all times.
- 3.11.4 All 1770 Central Lab visitors must sign in and obtain a "visitor's" ID badge from security personnel at the Guard Desk.
 - 3.11.4.1 **All Laboratories Administration visitors must be escorted at all times during the duration of the visit.**
- 3.11.5 The “visitor’s” ID badge must be displayed at all times while the visitor remains in the 1770 Central Lab.

3.12 Americans with Disabilities Act (ADA)

The Laboratories Administration will cooperate with **medically impaired employees** and their physicians to meet medical recommendations without unreasonably disrupting the normal work environment. The Laboratories Administration will conform to all requirements of the Americans with Disabilities Act (ADA).

3.13 Biohazard Bags

- 3.13.1 Biohazard bags should be used to line an approved autoclave container. Waste may then be placed inside the lined autoclave can for appropriate decontamination and disposal.
- 3.13.2 Do not use Biohazard bags in conjunction with any unapproved container, such as a trashcan or cardboard box.
- 3.13.3 Biohazard bags should not be sealed within the autoclave can. Bags should be open to allow entry of steam necessary to decontaminate the contents. Culture plates may be placed in brown paper bags. These bags must be placed into autoclave cans prior to autoclaving. Other infectious laboratory waste which may possibly puncture a Biohazard bag should be placed inside a rigid sharps container. Never place waste into an autoclave bag, and transfer the bag to another container prior to its removal for autoclaving and disposal.
- 3.13.4 Sharps must be placed into a rigid "SHARPS" container designed for that purpose and disposed of separately.

3.14 Electrical Safety

Wherever there are electrical outlets, plugs, wiring or connections, there is danger of electrical shock or burns. The usual "do's" and "don'ts" of protection against electrical shocks, burns and fires in the home and industry are equally applicable to the laboratory. Policies that must be followed regarding electrical safety are:

- 3.14.1 Grounding - All instruments and equipment, including all household type appliances (e.g., microwaves) must be grounded using a 3-prong plug or be double insulated.
- 3.14.2 Voltage - Know the difference between 110-volt and 220-volt plugs and outlets in your laboratory. There is no safe voltage. Low-voltage electric currents that pass through the body can have dangerous effects relating to the amperage, frequency and pathway of the current, not necessarily the voltage.
- 3.14.3 Avoid using extension cords except when absolutely necessary. When in use, they should properly grounded using a 3-prong plug. Multiple plugs are prohibited. When power strips are needed, the SSO, or in the case of computers IT staff, must approve their use. Cords should not be placed in areas where they may cause tripping.
- 3.14.4 Moisture - Electrical connections should not be handled with damp hands or when standing in or near water. Turn off a motor immediately if liquid has been spilled on it. Allow the motor to dry completely inside and out before resuming operation. Place an appropriate warning sign on the motor until it is dry.

- 3.14.5 Flammable Vapors - Electrical equipment cannot be operated in an area exposed to flammable vapors unless the equipment is known to be, and labeled, **Explosion Proof**.
- 3.14.6 Inspections - Properly trained maintenance personnel should survey the loads on individual circuits regularly. Open equipment, such as motors and relays, should be inspected and cleaned of dust and grease accumulations. **NOTE:** Most fires in motors are associated with dust buildup. Visually inspect external wires and switches before using instruments.
- 3.14.7 Building Electrical System - Repairs by unauthorized persons to the electrical system of the building are prohibited. Any work performed on switches, outlets or circuit boxes (fuses, circuit breakers) must be referred to Forest City Property Manager, 443-681-3818.
- 3.14.8 Equipment Repair –Do not attempt electrical repair or service to instruments while they are connected to a power source. If ceiling lights are out, please follow Property Management protocols. Refer to Forest City Tenant Handbook.
- 3.14.9 Shocks - Report faulty wiring immediately. Small shocks often precede major ones. When a shock is felt, shut off the current and/or unplug the instrument. Never use an instrument that is causing shocks. It is potentially dangerous, and any results from the instrument may be inaccurate.
- 3.14.10 Worn Wires – Do not use worn wires. Fill out work orders to have Maintenance Shop personnel replace connections immediately when there is any sign of thinning insulation. (**NOTE:** Always pull wires at the plug-head. Yanking wires by the tail damages the wire's prongs and insulation resulting in additional repairs).
- 3.14.11 See Electrical Burns, Shock, and Accidents in **Section 2.9**.
- 3.15 Compressed Gas Safety
- 3.15.1 Department of Transportation (DOT) Markings - All cylinders used for shipping are controlled by the DOT Office of Hazardous Materials. DOT regulations govern the design, materials, manufacturing and, testing of compressed gas cylinders. Evidence that a cylinder is made in strict accordance with these regulations is stamped on each cylinder shipped from the factory.
- 3.15.2 Handling and Transportation - Cylinders that contain compressed gases are primarily shipping containers. They should not be subjected to rough handling or abuse. Such misuse can seriously weaken a cylinder and render it

unfit for further use, or transform it into a rocket having sufficient thrust to drive it through masonry walls.

3.15.2.1 Protect the valve during transportation by leaving the valve's cover cap screwed on hand-tight until the cylinder is in place and ready for actual use.

3.15.2.2 Never roll or drag a cylinder. Use a suitable hand truck with the cylinder strapped securely in place. Never handle more than one cylinder at a time.

3.15.3 Storage - Cylinders of compressed gases should be stored in well ventilated, dry areas. All storage and use of compressed gases should be in compliance with OSHA regulations.

3.15.3.1 Compressed gas cylinders should not be stored near sources of ignition, or be exposed to corrosive chemicals or vapors. They should not be stored where heavy objects might strike or fall on them.

3.15.3.2 The cylinder storage area should be posted with the names of the gases stored. If gases of various types are stored in the same location, the cylinders should be grouped by type of gas (e.g., flammable, toxic, or corrosive).

3.15.3.3 Full and empty cylinders should be stored in separate portions of the storage area. Older stock should be used first with minimum handling of other cylinders.

3.15.3.4 Cylinders and valves are typically equipped with various safety devices, including a fusible metal plug that melts at 70-95°C. Although most cylinders are designed for safe use to a temperature of 50°C, they should not be placed near radiators, steam pipes, boilers, or other sources of heat.

3.15.3.5 Cylinder caps to protect the container withdrawal valve should be in place at all times during storage and when transporting.

3.15.3.6 All cylinders must be stored in an upright position within a cage, or secured by chain, strap or floor stand in an upright position.

3.15.3.7 Oxygen should be stored a minimum of 20 feet away from any flammable or combustible materials, or separated by a noncombustible barrier at least 5 feet high, and a fire resistance rating of at least 30 minutes.

- 3.15.3.8 In order to easily identify the contents of cylinders, vendors will paint them various colors. However, this color coding is NOT a reliable method for identification of their contents. The stenciled or printed name on the cylinder is the only acceptable method of identifying a cylinder's contents.
- 3.15.3.9 Make sure all cylinders have labels stating their contents. If a label is missing or illegible, do not use the cylinder. **Return it to the vendor.**
- 3.15.3.10 Some compressed gas cylinders are designed to vent under high pressure. The vent should be aimed in a safe direction. If you suspect a gas cylinder is leaking, follow the procedures outlined in **Section 2.10.**
- 3.15.3.11 Damaged cylinders should be returned to the vendor with a tag indicating they are damaged.
- 3.15.3.12 Refer to the Chemical Hygiene Manual, 1770 Gas Cylinder Manifold Location and Identification List. Appendix J”
- 3.15.4 Safe Laboratory Use of Compressed Gases – Every employee should follow these steps when receiving, connecting, and using compressed gases:
 - 3.15.4.1 Upon delivery, check the stenciled or painted label on each cylinder to ensure it contains the correct gas. If a cylinder is delivered without a proper label and contains only a tag or color code, or if there is **ANY** concern regarding a cylinder's contents, return it to the warehouse or supplier. (**NOTE:** There is no standard color coding system for compressed gas cylinders. Color is not a reliable method of identifying a cylinder's contents).
 - 3.15.4.2 All newly delivered cylinders must be secured in an upright position using a chain, strap, or floor stand.
 - 3.15.4.3 Main Valve Check - Check each cylinder for leaks at the main valve using "Snoop" or soapy water, and look for gas bubbles. If a leak is found, refer to Section 2.10. **NEVER** tamper with any part of the valve, safety nut, or stem packing nut.
 - 3.15.4.4 Different needle valves and regulators are designed specifically for different families of gases. Special connections are assigned to each family of gases to prevent hazardous interconnections.
 - 3.15.4.5 Check the CGA number for each cylinder valve to ensure the regulator fitting is properly matched. Do **NOT** attempt to install

an unmatched regulator using any adapter not previously approved by the SSO.

- 3.15.4.6 Do not force threads or connectors. Generally, left-hand threads are reserved for flammable gases and right-hand threads for non-flammable gases.
- 3.15.4.7 Threads and surfaces must be clean and tightly fitted. The use of oil, grease or other lubricants on valves, regulators or fittings is prohibited. (**NOTE:** Grease or oil on a cylinder valve or nut where the cylinder contains a flammable, especially oxygen, can ignite spontaneously).
- 3.15.4.8 After installing the regulator, check for leaks using "Snoop" or soapy water and look for gas bubbles. If a leak is present, tighten the connector or reconnect the regulator using Teflon tape to seal the connection. Recheck for leaks. If a leak is still present, obtain a new cylinder. (**NOTE:** Leaks are usually due to damaged faces at connectors or improper fittings. Do not attempt to force an improper fit. Doing so may damage a previously undamaged connection and compound the problem).
- 3.15.4.9 Open valves **SLOWLY**. Do not stand directly in front of gauges. The gauge face may blow out. Do not force valves that stick.
- 3.15.4.10 Fine-tuning of flow should be regulated by the needle valve.
- 3.15.4.11 Close all cylinder valves when gas is not in use. Valves on all flammable gas cylinders must be shut off when the laboratory is unattended.
- 3.15.4.12 No more than two cylinders should be joined or tied together. However, several instruments or outlets are permitted for a single cylinder.
- 3.15.4.13 Mark all empty cylinders, "**EMPTY**" or "**MT**".
- 3.15.4.14 Do not expose cylinders to high temperatures (>50°C) and keep flammable gases away from spark sources.

3.16 Elevator Use 1770 Central Lab

The movement of supplies, samples and other materials is an essential part of a large laboratory's operation. By necessity, this movement includes materials that pose toxic, infectious, and safety hazards to people. In order to minimize exposure of personnel, the following elevator policy must be followed:

3.16.1 Elevators (#3 & #4) or freight elevator (#5) should be used for the transport of lab carts and lab materials (e.g., Bio Transport Containers).

3.16.1.1 All materials must be safely and securely held to avoid spills, or carried on a cart. BioTransport Containers must be used when transporting blood tubes or tube specimens, or infectious materials in tubes that may contain blood pathogens, or to prevent the release of infectious vapors or aerosols.

3.16.2 Elevators (#1 & #2) are designated as passenger/visitor elevators and should be restricted to passenger use only.

3.16.2.1 Lab staff members are not permitted to wear gloves on the elevators, or to operate the elevator.

3.16.3 Freight elevator (#5) is designated for the transport of equipment, supplies, and any other laboratory related materials (such as lab carts, gas cylinder carts, waste barrels, specimens and samples, etc.).

3.16.4 It is the responsibility of Administrators, Division Chiefs and Section and Unit Heads to enforce this policy in conjunction with the SSO.

4.0 RIGHT-TO-KNOW LAW (HAZARDOUS COMMUNICATION)

Laboratory employees, by the very nature of their workplace, may be exposed to a wide variety of hazardous and toxic substances. A thorough knowledge of the nature of chemical and biological hazards an employee may encounter in the workplace is essential to employing safe laboratory techniques. Employee access to information about hazardous and toxic substances in the workplace is guaranteed under federal law in the OSHA of 1970 (29 CFR 1910.1200 Hazardous Communication). (For those working in Select Agent Program registered laboratories - See Biological Agent Incident Response Plan, Appendix F – MSDS).

4.1 Categories of Hazardous Biological Agents

The principal hazardous characteristics of an agent are: its capability to infect and cause disease in a susceptible human or animal host, its virulence as measured by the severity of disease, and the availability of preventive measures and effective treatments for the disease. The classification below correlates with but does not equate to Biosafety levels (Refer to section 6.5 for Biosafety Level classification). A biological risk assessment will determine the degree of correlation between an agent's risk group classification and biosafety level. Technical work with certain infectious agents requires designated immunizations and/or tests (refer to Section 7.2).

Classification of Infectious Microorganisms by Risk Group (refer to current BMBL)

Risk Group Classification	NIH Guidelines for Research involving Recombinant DNA Molecules 2002₂	World Health Organization Laboratory Biosafety Manual 3rd Edition 2004₁
Risk Group 1	Agents not associated with disease in healthy adult humans.	(No or low individual and community risk) A microorganism unlikely to cause human or animal disease.
Risk Group 2	Agents associated with human disease that is rarely serious and for which preventive or therapeutic interventions are <i>often</i> available.	(Moderate individual risk; low community risk) A pathogen that can cause human or animal disease but is unlikely to be a serious hazard to laboratory workers, the community, livestock or the environment. Laboratory exposures may cause serious infection, but effective treatment and preventive measures are available and the risk of spread of infection is limited.
Risk Group 3	Agents associated with serious or lethal human disease for which preventive or therapeutic interventions may be available (high individual risk but low community risk).	(High individual risk; low community risk) A pathogen that usually causes serious human or animal disease but does not ordinarily spread from one infected individual to another. Effective treatment and preventive measures are available.
Risk Group 4	Agents likely to cause serious or lethal human disease for which preventive or therapeutic interventions are not usually available (high individual risk and high community risk).	(High individual and community risk) A pathogen that usually causes serious human or animal disease and can be readily transmitted from one individual to another, directly or indirectly. Effective treatment and preventive measures are not usually available. ³

4.2 Categories of Hazardous Chemicals

Hazardous chemicals are defined in the MOSH law in technical terms. In general they include the following categories:

4.2.1 Combustible liquids, i.e. liquids, including mixtures, which have a flash point at or above 100°F.

4.2.2 Compressed gases.

4.2.3 Explosives, meaning a chemical that causes sudden, almost instantaneous release of pressure, gas and heat when subjected to sudden shock, pressure, or high temperature.

4.2.4 A flammable chemical, meaning a chemical that falls into one of the following categories:

4.2.4.1 Flammable aerosol.

4.2.4.2 Flammable gas.

4.2.4.3 A flammable liquid, i.e. a liquid, including mixtures, with a flash point below 100° F.

4.2.4.4 A flammable solid (as determined by method described in 16 CFR 1500.44).

4.2.4.5 An organic peroxide.

- 4.2.4.6 An oxidizer, meaning a chemical that initiates or promotes combustion in other materials, thereby causing fire either of itself or through the release of oxygen or other gases.
- 4.2.4.7 A pyrophoric chemical, meaning a chemical that will ignite spontaneously in air at a temperature of 130°F or below.
- 4.2.4.8 An unstable reactive chemical, meaning a chemical which, in the pure state, or as produced or transported, will vigorously polymerize, decompose, condense, or will become self-reactive under conditions of shocks, pressure, or temperature.
- 4.2.4.9 A water reactive chemical, meaning a chemical that reacts with water to release a gas that is either flammable or presents a health hazard.

4.3 Education and Training Programs

The Laboratories Administration provides mandatory education and training program which shall be designed to inform an employee of:

- 4.3.1 The nature and identity of hazardous chemicals and biological agents encountered in the workplace.
- 4.3.2 The appropriate work practices regarding hazardous chemicals and biological agents in the workplace.
- 4.3.3 The appropriate control programs regarding hazardous chemicals and biological agents in the workplace.
- 4.3.4 The appropriate protective measures regarding hazardous chemicals and biological agents in the workplace.
- 4.3.5 Emergency procedures relating to hazardous chemicals and biological agents in the workplace.
- 4.3.6 Appropriate disposal of hazardous chemicals and biological agents.

4.4 Materials Safety Data Sheets (MSDS)/ Safety Data Sheets (SDS)

The Laboratories Administration maintains any material safety data sheets that are received with incoming shipments of hazardous chemicals or biological agents, and ensures they are available to employees, designated representatives, or persons providing health care to employees.

- 4.4.1 A file of MSDS/SDS for all hazardous chemicals in use will be maintained in the Office of Laboratory Safety (132C) and each laboratory unit in which the

chemical is located. **Each lab is required to keep a printed Chemical Inventory List and printed MSDS/SDS in a binder (See 1.2 and Chemical Hygiene Plan).** A sample MSDS/SDS can be found in **Appendix B**. All chemical MSDS/SDS have the same basic format and contain the same basic types of information as follows:

4.4.1.1 Identity, trade name and/or chemical name of the product, or if a mixture:

4.4.1.1.1 The list of ingredients that constitute the known hazard of the mixture, or;

4.4.1.1.2 List of ingredients that have adverse health effects and comprise 1% or more of the mixture, (except for carcinogens that comprise 0.1% or more of the mixture).

4.4.1.2 Physical and chemical characteristics, including flash point and vapor pressure.

4.4.1.3 Health hazards: signs and symptoms of exposure, and medical conditions aggravated by exposure.

4.4.1.4 Primary routes of entry.

4.4.1.5 Exposure limits.

4.4.1.5.1 OSHA Permissible Exposure Limits (PEL).

4.4.1.5.2 American Conference of Governmental Industrial Hygienists (ACGIH) Threshold Limit Values (TLV).

4.4.1.6 Carcinogenicity listed by:

4.4.1.6.1 National Toxicology Program (NTP).

4.4.1.6.2 International Agency for Research on Cancer (IARC).

4.4.1.7 OSHA precautions for safe handling.

4.4.1.8 Control measures.

4.4.1.8.1 Workplace and personal protective clothing.

4.4.1.8.2 Emergency and first aid procedures.

4.4.1.8.3 Date of MSDS/SDS preparation.

4.4.1.8.4 Identification of the manufacturer and the MSDS/SDS preparer.

4.5 Control Measure for Biological Agents

All biological MSDSs and Risk Assessments have the same basic format and contain the same basic types of information as follows: Recommended are those from the Public Health Agency of Canada, available at <http://www.phac-aspc.gc.ca/lab-bio/res/psds-ftss/index-eng.php>

4.5.1 Section I – Infectious Agent

- 4.5.1.1 Name
- 4.5.1.2 Room(s) registered
- 4.5.1.3 Synonym or cross-reference
- 4.5.1.4 Characteristics

4.5.2 Section II – Health Hazard

- 4.5.2.1 Pathogenicity
- 4.5.2.2 Epidemiology
- 4.5.2.3 Host Range
- 4.5.2.4 Infectious Dose
- 4.5.2.5 Mode of Transmission
- 4.5.2.6 Incubation Period
- 4.5.2.7 Communicability

4.5.3 Section III – Dissemination

- 4.5.3.1 Reservoir
- 4.5.3.2 Zoonosis
- 4.5.3.3 Vectors

4.5.4 Section IV – Viability

- 4.5.4.1 Drug Susceptibility
- 4.5.4.2 Drug Resistance
- 4.5.4.3 Susceptibility to Disinfectants
- 4.5.4.4 Physical Inactivation

4.5.4.5 Survival Outside Host

4.5.5 Section V – Medical

4.5.5.1 Surveillance

- 4.5.5.2 First Aid/Treatment
- 4.5.5.3 Immunization
- 4.5.5.4 Prophylaxis

4.5.6 Section VI – Laboratory Hazards

- 4.5.6.1 Laboratory-acquired infections
- 4.5.6.2 Sources/Specimens
- 4.5.6.3 Primary Hazards
- 4.5.6.4 Special Hazards

4.5.7 Section VII – Recommended Precautions

- 4.5.7.1 Containment Requirements
- 4.5.7.2 Protective Clothing
- 4.5.7.3 Other Precautions

4.5.8 Section VIII – Handling Information

- 4.5.8.1 Spills
- 4.5.8.2 Disposal
- 4.5.8.3 Storage

4.5.9 Section IX – Miscellaneous Information

- 4.5.9.1 Date Prepared
- 4.5.9.2 Prepared by

4.6 Removal or Defacing Label

Original labels on containers of hazardous chemicals and biological agents are not to be removed or defaced. All containers of chemicals and biological agent reagents must be properly and clearly labeled.

4.7 Providing Information

When safety data sheets are not available, the employer shall provide any information relating to hazardous chemicals and biological agents to employees, designated representatives, or persons providing health care to employees.

4.8 Employer's Education and Training Responsibility

The employer shall provide an employee with training and educational resources for hazard communication. This includes:

4.8.1 MSDS/SDS

4.8.2 Chemical inventory lists

4.8.3 Labels and other warning signs

4.8.4 Chemical Hygiene Plan

4.8.5 Exposure Control Plan

4.8.5.1 For those employees listed on the Laboratories Administration's registration for the APHIS/CDC Select Agent Program, they will receive initial and annual updates in:

4.8.5.1.1 Select Agent Program Annual Biosafety and Security Training

4.8.5.1.2 Select Agent Program Agent-Specific Training

4.9 Employee Rights

An employee or designated representative may request access to a chemical inventory list and any MSDS/SDS maintained by the employer.

5.0 CHEMICAL LABORATORY SAFETY

(Please note: employees should also review the current Chemical Hygiene Plan)

5.1 General Information and Required Procedures

Employee access to information regarding hazardous chemicals in the workplace is guaranteed under federal law (Right-to-Know-Law). An awareness of the dangers posed by apparatus and instruments used in the laboratory is also essential.

5.1.1 Hazardous Chemicals Commonly Found in a Chemistry Laboratory (See Chemical Hygiene Plan for additional information).

5.1.1.1 Corrosive Chemicals - The major classes of corrosive chemicals are strong acids and bases, dehydrating agents, and oxidizing agents.

5.1.1.2 Strong acids - All concentrated strong acids can damage the skin and eyes. Exposed areas should be flushed immediately with water. Nitric, chromic, and hydrofluoric acids are especially damaging because of the types of burns they inflict.

5.1.1.3 Strong bases - The common strong bases are potassium hydroxide, sodium hydroxide, and ammonia hydroxide. Ammonia is a severe bronchial irritant and should be used in a well-ventilated area only. Metal hydroxides are extremely damaging to the eyes. Should exposure occur, the affected areas should be washed immediately using an eyewash station or safety shower. Supervisor and SSO should be notified, the First Report of Injury form completed, and the employee should be taken to the State medical provider for evaluation and if further treatment is needed.

5.1.1.4 Dehydrating Agents - Strong dehydrating agents include concentrated sulfuric acid, sodium hydroxide, phosphorus pentoxide, and calcium oxide. Heat is involved on mixing these substances with water, and mixing should always be done by adding the agent to water to avoid a violent reaction and spattering. Because of their affinity for water, these substances can cause severe burns on contact with the skin. Affected areas should be washed promptly with large volumes of water.

5.1.1.5 Oxidizing Agents - In addition to their corrosive properties, powerful oxidizing agents present fire and explosion hazards on contact with organic compounds and other oxidizable substances. Strong oxidizing agents should be stored and used in glass or other inert containers (preferably unbreakable), and corks and rubber stoppers should not be used. **NOTE: Cleaning solution made from chromic acids and perchloric acids are banned from use in all laboratories.**

5.2 Routes of Exposure and Response

5.2.1 Inhalation of toxic vapors, gases or dusts can produce poisoning by absorption through mucous membranes of the mouth, throat and lungs, and can seriously damage these tissues by local action. Inhaled gases and vapors may pass rapidly into the capillaries of the lungs and be carried into the circulatory system. This absorption can be extremely rapid. Several chemicals (e.g., mercury and its derivatives) and some common solvents (e.g., benzene) are cumulative poisons that can damage the body through exposure to small concentrations over a long period of time. The ACGIH produces annual lists of Threshold Limit Value (TLV) and Short Term Exposure Limits (STEL) for common chemicals used in laboratories. These values are guides, not legal standards, and are defined as follows:

5.2.1.1 TLV - Time-weighted average concentration for a normal 8 hour work day to which nearly all employees may be repeatedly exposed without adverse effects.

5.2.1.2 STEL - Maximum concentration to which employees can be exposed

for periods up to 15 minutes. Should be limited to no more than 4 exposures per day, with periods of at least 60 minutes between exposures. The total time-weighted exposure per day should not exceed the TLV.

- 5.2.2 Ingestion - Many chemicals used in the laboratory are extremely dangerous if they are swallowed. To prevent entry of toxic chemicals into the mouth, laboratory employees must wash their hands immediately after use of any toxic substance, and before leaving the laboratory. Food or drink must not be stored or consumed in areas where chemicals are used or stored. Chemicals should not be tasted. Pipetting and siphoning of liquids should **NEVER** be done by mouth.
- 5.2.3 Skin Contact - Contact with the skin is a frequent mode of chemical injury. A common result of skin contact is a localized irritation. An appreciable number of materials are absorbed through the skin with sufficient rapidity to produce systemic poisoning. Direct contact in the eye by chemicals is of particular concern because these organs are so sensitive to irritants. Alkaline materials, phenols, and strong acids are particularly corrosive and can cause permanent loss of vision. In addition, eyes are very vascular and provide for rapid absorption of many chemicals. Eye and skin contact with chemicals should be prevented by using appropriate protective equipment. All laboratory employees must wear safety glasses or face shield while working in lab areas, and wear face shields when performing tasks that may create a splash. Protection against skin contact may be obtained by using appropriate gloves, laboratory coats, aprons, face shields and other protective devices.
- 5.2.4 Injection - Exposure to toxic chemicals by injection seldom occurs. However, it can inadvertently occur through mechanical injury from glass or metal contaminated with chemicals, or when chemicals are handled in syringes.

5.3 Ordering and Procuring Chemicals

- 5.3.1 Refrain from ordering chemicals in greater amounts or more units than will be used before shelf life expires. It proves less expensive to purchase several smaller quantities of a given chemical even though bulk purchases may be initially cheaper. It can cost from 10 to 100 times as much to dispose of a chemical as to purchase it.
- 5.3.2 Upon receipt of any new chemical, provide the Safety & Security Officer with a copy the MSDS and retain the original copy in the laboratory.
- 5.3.3 Never accept an opened or unlabeled container from the warehouse or supplier.

5.4 Labeling Procedures and Warning Signs

- 5.4.1 Exact chemical name and concentration
- 5.4.2 Date received and opened, or prepared
- 5.4.3 Name of preparer
- 5.4.4 Shelf life or expiration date
- 5.4.5 Type of hazard (e.g., flammable, irritant)
- 5.4.6 Required Personal Protective Equipment
- 5.4.7 Labels must be durable. Do not use wax pencils on glass or water-soluble ink on tape.
- 5.4.8 Unlabeled (unidentified) bottles of chemicals should not be opened. They should be turned over to the Safety Officer for disposal.
- 5.4.9 **In addition, follow Divisional SOPs, Division QA Manual, and Laboratories Administration QA Manual** (See current QA Manual).
- 5.5 Storage of Chemicals
 - 5.5.1 Examination - Stored chemicals should be examined at periodic intervals. They **MUST** be examined at least once a year when the annual chemical inventory lists are prepared. Chemicals with “date open” exceeding 10 years, have deteriorated, have questionable labels, are leaking, have corroded caps, or have developed any other problem, must be disposed of by the SSO. (See current Chemical Hygiene Plan for the Generator of Hazardous Waste Form).
 - 5.5.2 General Chemical Storage Procedures
 - 5.5.2.1 Rotate chemical stocks.
 - 5.5.2.2 Catalog and place chemicals neatly and orderly, making sure incompatible chemicals are not stored together.
 - 5.5.2.3 Store corrosive chemicals in appropriate storage cabinets.
 - 5.5.2.4 Store large containers near the floor.
 - 5.5.2.5 Store flammables in specially designed storage cabinets.
 - 5.5.2.6 Volatile solvents must be stored in explosion-proof refrigerators or a solvent cabinet. When possible, volatile solvents should be packed

with nitrogen.

5.5.2.7 When chemicals are dispensed from bulk containers or drums, the following special precautions must be taken:

5.5.2.7.1 Secure the container to prevent rolling.

5.5.2.7.2 Mount a self-closing faucet on the container.

5.5.2.7.3 Ground containers before dispensing any flammable liquids.

5.5.2.7.4 Provide a mechanism for catching drips from the faucet between uses.

5.5.2.7.5 Properly bond metallic receiving vessels to drums. Always use carts or hand trucks when transferring large containers, such as carboys and drums.

5.5.2.7.6 Flammables Storage

5.5.2.7.6.1 See **Appendix B** for more information concerning liquid classifications.

5.5.2.8 Incompatible Chemicals Storage - The term "incompatible chemicals" refers to chemicals which can react with each other violently, with evolution of substantial heat, to produce flammable or toxic products. Incompatible chemicals must always be handled, stored, and packed so they cannot come into contact with each other. **Appendix B** lists specific compounds that can pose reactivity hazards. Additional chemical reaction hazards can be found in the appendix.

5.5.3 Chemical Lab PPE - Every laboratory employee must familiarize themselves with the location and proper use of the available PPE. Supervisors must provide instruction on the proper use of PPE to every employee who may need it, and enforce Administration PPE requirements.

5.5.3.1 Eye Protection

5.5.3.1.1 All employees must wear eye protection when handling or working with hazardous chemicals in the laboratory.

5.5.3.1.2 Contact lenses should not be worn when working with chemicals in the laboratory. Gases and vapors can be concentrated under such lenses and cause permanent eye damage. Furthermore, with a chemical splash into the eye,

it is often nearly impossible to remove the contact lens to irrigate the eye because of involuntary spasm of the eyelid.

- 5.5.3.1.3 Eye protection is required in all lab areas. It is the responsibility of the immediate supervisor to enforce eye protection policy.

5.5.3.2 Gloves

- 5.5.3.2.1 Skin contact is a potential source of exposure to toxic materials. Wearing appropriate gloves is an important precaution in chemistry laboratories.
- 5.5.3.2.2 Proper protective gloves must be worn whenever the potential for contact with corrosive or toxic materials and materials of unknown toxicity exists.
- 5.5.3.2.3 Gloves should be selected on the basis of the material being handled, the particular hazard involved, and their suitability for the operation being conducted. Common glove materials include neoprene, polyvinyl chloride, nitrile, and butyl and natural rubbers. These materials differ in their resistances to various substances (See **Appendix B, Table 5**). Refer or consult glove manufacturer recommendations for glove usage.
- 5.5.3.2.4 Before each use, reusable gloves should be inspected for discoloration, punctures and tears. Before removal, gloves contaminated with chemicals should be rinsed. **NOTE:** Some gloves, such as polyvinyl alcohol, are water permeable.
- 5.5.3.2.5 Chemicals eventually permeate glove materials. However, they can be used safely for limited time periods if specific use and glove characteristics (e.g., thickness, permeation rate and time) are known. This information can be obtained from supply catalogs and glove manufacturers.
- 5.5.3.2.6 Non-disposable gloves should be replaced periodically, depending on frequency of use and permeability to the substance(s) handled. Gloves overtly contaminated (if impermeable to water) should be rinsed before being removed for disposal as hazardous waste.

- 5.5.3.3 Lab Coats: All employees must wear lab coats when in a lab area. Lab coats are intended to prevent contact with dirt and minor chemical

splashes or spills encountered in laboratory work. The laboratory coat protects clothing, but may itself present a hazard (e.g., combustibility) to the wearer. Laboratory coats do not significantly resist penetration by organic liquids and, if significantly contaminated by them, should be removed immediately and placed in a biohazard bag or container. The employee must contact their supervisor and the SSO.

5.5.3.4 Other clothing, jewelry, hair, and show-lab employees are required to follow the Laboratories Administration Dress Code Policy, outlined in the current Employee Handbook.

5.5.4 Use of Chemical Fume Hoods

Chemical fume hoods provide a physical barrier between the employee and chemical reactions. This provides significant protection from chemical splashes or sprays, fires, and minor explosions. Fume hoods act as local ventilation devices to be used to prevent toxic, offensive, or flammable vapors from entering the general laboratory atmosphere. Chemical fume hoods provide an effective containment device for accidental spills of chemicals. The following factors should be remembered in the daily use of hoods:

5.5.4.1 Kewaunee Scientific Corp., metal and NuAire Inc. polypropylene Variable Air Volume (VAV) chemical fume hoods are used throughout the Central Lab. VAV chemical fume hood maintains a constant face velocity regardless of sash position. To ensure accurate control of the average face velocity, VAV hoods incorporate a closed loop control system. The system continuously measures and adjusts the amount of air being exhausted to maintain the required average face velocity. VAV have been set to maintain an average face velocity of between 80-100 fpm.

5.5.4.2 Chemical fume hoods should not be regarded as a means for disposing or storing chemicals. Materials of need should be kept to a minimum. These materials or chemicals should not block vents or alter airflow patterns.

5.5.4.3 Chemical fume hoods are annually recertified by the SSO to ensure adequate face velocity (average 100 fpm) and the absence of excessive turbulence. If inadequate hood performance is suspected, do not use until it has been evaluated and/or serviced if necessary.

5.5.4.4 The sash should be kept as low as possible, except when adjustments of apparatus within the hood are being made. Keeping the face opening of the hood smaller improves the overall performance of the hood. Use a safety shield in addition to the hood sash if a danger of explosion is present.

5.5.4.5 The airflow patterns can affect the proper performance of chemical fume hood.

5.5.4.5.1 Keep lab doors shut when the hood is operating.

5.5.4.5.2 Avoid rapid movements inside the hood, and traffic in front of the hood.

5.5.4.5.3 Keep the hood free of clutter. Keep the amount of materials inside the hood to a minimum.

5.5.4.5.4 Elevate large equipment off the work surface to the hood to improve air flow.

5.5.4.5.5 Work at least 6 inches inside the hood.

5.5.4.5.6 Use an airflow indicator (tell-tale) such as an 8-inch strip of lightweight material dangling from the sash and the airflow meter to ensure proper airflow.

5.5.4.5.7 If the chemical fume hood is not functioning properly inform your supervisor and contact facility manger, so the repair process can be initiated.

5.5.4.6 Hoods are not intended as permanent storage sites for chemicals. Materials stored in them should be kept to a minimum. Stored chemicals should not block vents or alter airflow patterns.

5.5.4.7 VAV chemical fume hoods are designed for the sash to be closed at the end of the day.

5.5.5 Analytical Instrumentation/Equipment Operating Precautions Operating manuals should be available for all instruments in the laboratory. All safety procedures recommended by the manufacturer should be observed along with any others based on experience. All persons operating laboratory instruments or working in the near vicinity must be familiar with the dangers or potential hazards involved, and the proper measures to take in case of an emergency.

5.5.6 Chemical Waste Disposal - See **Section 9.2**.

6.0 RADIOLOGICAL SAFETY

6.1 General Radiation Safety Procedures

Non-essential personnel are not allowed in the laboratory while radioactive procedures are in progress. All persons handling radioactive material must be familiar with the properties of and hazards associated with such materials. The standard source of such information is the National Bureau of Standards Handbook #92, "Safe Handling of Radioactive Materials". Those working with radioactive materials should familiarize themselves with its contents. This and other references are listed at the end of this section. Proper licensing is required. Any questions should be addressed to the Lab Administration Radiation Safety Officer (443-681-3856), or to the Radiological Health Program, Maryland Department of the Environment (410-631-3300).

- 6.1.1 Protective Clothing - Wear laboratory coats or other protective clothing at all times in areas where radioactive materials are used. When and where appropriate, wear disposable polymer gloves, safety glasses, goggles or face shields. Do not wear disposable gloves outside areas designated for radioactive work.
- 6.1.2 Lined Trays - Use easily decontaminated trays (e.g., stainless steel, fiberglass) lined with absorbent plastic-backed pads (diapers) to limit radioisotope use on workbenches, and to contain contamination in the event of a spill. Absorbent paper should be used to cover workbenches, trays and other surfaces where radioactive material is handled.
- 6.1.3 Dosimeters - Employees will obtain and wear appropriate personnel radiation dosimeters when there is the potential of exposure to penetrating beta and gamma emitters. Nuclear Regulatory Commission regulations require that occupationally exposed personnel be monitored for external or internal radiation dose or both, when there is a potential for them to receive a dose greater than 1/4 of the quarterly dose limits specified in **Appendix C, Table 1**. A permanent record of radiation doses received by personnel is required by the regulations. Personnel dosimetry reports are legal records that document whether the radiation dose received by the individual has been maintained within protection limits. The routine (typically monthly) dosimetry reports help assess the adequacy of personnel protection, and, in the event of an elevated dose, will serve to alert personnel of a need for improvement or change in procedures (Employees working with only pure beta emitters having a maximum energy of less than 0.2 MeV will not be required to wear dosimeters).
- 6.1.4 Eating, drinking, smoking, applying cosmetics, and mouth pipetting are forbidden in areas contaminated with or employing radioactive materials.
- 6.1.5 Double Containers – Whenever practical, radioactive materials being carried within the laboratory should be placed within another container to minimize the danger of spills. Radioactive material in liquid form should be stored and transported in double containers.

- 6.1.6 Hand Tools - Use remote handling tools (forceps tongs, clamps, etc.) along with appropriate gloves to prevent high hand dose, and possible hand contamination. Label tools with a radioactive sticker until they have been decontaminated.
- 6.1.7 Shielding - Obtain and use appropriate shielding. Use Lucite for intermediate to high-level beta emitters and lead for gamma emitters.
- 6.1.8 Volatile Radioisotopes - Potentially volatile or airborne radioisotopes may be used only in a properly ventilated hand or glove box, or hood.
- 6.1.9 Labeling
 - 6.1.9.1 Label all tubes, flasks and contaminated containers with special "yellow" radioactive stickers.
 - 6.1.9.2 Label all radioisotope containers with a "Caution Radioactive Material" tag or tape indicating radioisotope activity and date of assay.
 - 6.1.9.3 Label all radioactive use and storage areas with required caution. Post "Caution Radioactive Materials" signs on doors and storage areas of all restricted use areas. Also post "Caution Radiation Area" signs in any areas where radiation exposure level to personnel is between 5 and 100 mR/h.
 - 6.1.9.4 Do not work with radioactive materials in areas not posted with the yellow radioactive sign. Do not centrifuge radioactive materials in other areas.
- 6.1.10 Clean up - At the end of the workday, clear all workbenches where radioactive materials were used. All "hot" material must be returned to the isotope storage room. All radioactive waste must be properly disposed of. Use a portable radiation-monitoring instrument (e.g. Geiger counter) to survey hands, clothing, and shoes for contamination after each procedure or before leaving work.
- 6.1.11 Incoming Radioisotope Shipments - Radioisotope shipments must be inspected and surveyed with a Geiger counter upon receipt. Wear disposable gloves when handling the shipping container; and open the shipment in a hood if the radioisotope is potentially volatile. Properly dispose of the shipping carton by removing labels and blacking out radioactive-material markings. **All individuals who wish to purchase and use radioactive materials must apply to the RSO for authorization.** The RSO and the SSO will provide training regarding the safe handling of radioactive material.

6.1.12 Radioisotope Security - Properly identify all radioactive materials and guard against unauthorized removal. Identification shall be in accordance with the required inventory control program. Current records of receipt, use, transfer, and disposal of radioactive materials must be kept current in a specified format. Records will be considered adequate only when all materials can be accounted for at any given time from the inventory records. All records must be available for inspection on reasonable notice by the Division of Radiation Control, Maryland Department of the Environment.

6.2 Radiation Surveys

Radiation Surveys (Wipe Tests): It is recommended that precautionary monitoring of work areas be performed on a weekly basis. Contamination smear surveys must be performed periodically (recommendation: on a weekly basis in all radioisotope storage and use areas, to assure that removable activity levels do not present an appreciable radiation exposure potential). See Laboratory Safety: Principles and Practices, pp. 251-257, for a full explanation of wipe test policy and procedures.

6.2.1 Monitoring should consist of:

6.2.1.1 A Geiger counter survey.

6.2.1.2 Collection of wipes samples of bench tops, floors etc. to determine contamination levels.

6.2.1.3 Maintenance of complete records of the monitoring results.

6.2.2 Recommended Limits for Removable Contamination

6.2.2.1 In laboratory storage and use areas, these are 250 dpm/100 cm² for intermediate and high energy beta and for gamma emitters; and 500 dpm/100 cm² for low energy beta emitters limit is 100 dpm/100 cm².

6.2.2.2 With respect to personnel skin contamination the limit is 100 dpm/100 cm².

6.2.3 Wipe Tests - The usual method for determining removable contamination is a wipe test (filter paper smear) of a defined area of 100 cm² [approximately equal to the area covered by a 1-inch (ca. 2.5 cm) diameter filter paper moved 20 in (ca. 50 cm) along a surface].

6.2.3.1 Care should be taken to prevent hand contamination and cross contamination of the individual wipes.

6.2.3.2 The wipes should be numbered or coded before the survey; and the person performing the survey should wear disposable gloves.

- 6.2.3.3 Wipes should be stored separate from each other, and forceps should be used to place them into individual centrifuge vials or tubes.
- 6.2.3.4 Survey results should be recorded on a standard form that identifies laboratory areas surveyed and lists the results (dpm/100 cm²) for each area surveyed.
- 6.2.3.5 These records must be made available for employee review and for inspection purposes.

6.3 Radiation Dose: Units and Protection Limits

The operational philosophy of the Lab is to maintain all radiation exposure “As Low As Reasonably Achievable” (ALARA) a level to which radiation protection aims to reduce occupational exposure. ALARA is achievable through good laboratory practices, good radiation protection, planning and practice.

- 6.3.1 Radioactivity Measure - The radioactivity of a particular radioisotope is a measure of the rate at which the nuclei of the radioisotope decay or disintegrate. The commonly used unit of radioactivity is the curie (Ci) and is, by definition, the amount of a particular radioisotope that has a nuclear decay rate of 3.7×10^{10} disintegrations per sec (dps). This unit can also be expressed in terms of disintegrations per min (dpm: 2.22×10^{12} dpm). Other useful units of radioactivity are the millicurie (mCi), which is 10^{-3} Ci, and the microcurie (uCi), which is 10^{-6} Ci. Recently there has been an effort to introduce a new unit of radioactivity under the International System of Units (SI units), the Becquerel (Bq), defined as equal to 1 dps. **Appendix C** shows the relationship between curie and Becquerel units.
- 6.3.2 Radiation Exposure Units - Three terms or units are used when expressing radiation exposure and dose from sources of ionizing radiation: the roentgen, the rad, and the rem. The term used for radiation exposure is the roentgen (R), by definition a specific amount of ionization in air (2.58×10^4 Ci/kg air). The unit of absorbed radiation dose is the rad (0.01 J/kg), a measure of the energy deposited in an absorbing material. The rem is the unit of biological dose. For the most commonly encountered types of ionizing radiation (beta, gamma, and X-ray radiation) the rem dose is equal to the rad dose. For radiation protection purposes, the rad dose in tissue is approximately equal to the air exposure in roentgens for these same types of ionizing radiation. Therefore, the approximate rem dose can be determined or projected based on instruments, which measure radiation exposure (R) in air. Table 2 lists the SI units, the gray (Gy) and the sievert (Sv), which may be substituted for the rad and rem respectively, using the conversion factors indicated in the table.

- 6.3.3 Radiation Exposure Limits - Radiation exposure is often expressed in terms of

milliroentgens (mR) and is commonly measured as an exposure rate per unit of time (e.g., mR/min, mR/h). To protect employees exposed to ionizing radiation, federal regulatory agencies such as the Nuclear Regulatory Commission (NRC) and OSHA have adopted radiation dose limits and guides. Table 1 in **Appendix C** lists the recommended protection limits for various population groups. The dose limit for occupationally exposed persons is 5 rem/yr. or 1.25 rem per calendar quarter for whole body and gonadal exposure. The occupational dose limit for the hands and feet is considerably higher than that for the whole body. The limit for hands and feet is 75 rem/yr. or 18.74 rem per quarter

6.3.4 See **Section 9.0** for Waste Disposal.

6.3.5 See Section 10.0 for Reproductive Safety.

7.0 BIOLOGICAL SAFETY

All public health laboratory employees must realize they routinely handle and work with infectious microorganisms. If they do not receive adequate training or take adequate care, they may contract a laboratory-acquired infection.

7.1 Routes of Infection

Although the actual occurrence of an infection depends on both the virulence of the infecting agent and the susceptibility of the host, all infecting agents must first gain entry into the body through one of the following routes:

- 7.1.1 Direct inoculation through needle stick punctures, glass or scalpel cuts, animal bites, etc.
- 7.1.2 Contact with minor skin defects (e.g., small scratches, burns, scrapes, weeping or exudative lesions, areas of dermatitis) or mucous membranes.
- 7.1.3 Ingestion through failing to wash contaminated hands, or touching face, eyes, hair, and mouth with potentially contaminated gloves, etc.
- 7.1.4 Inhalation following the formation of aerosols and droplets from carelessly removing caps from tubes, heating needles too rapidly, tubes breaking in centrifuges, etc.
- 7.1.5 Vectors such as mosquitoes, ticks, fleas and other ectoparasites, especially if animal work is performed.

7.2 Vaccination/Immunization Requirements

Employees hired to work in specific laboratories must receive designated immunizations and/or tests prior to being allowed to work with certain infectious specimens and agents encountered in those laboratories. Immunization policies and recommendations are as follows:

- 7.2.1 Employee vaccinations/immunizations are subject to Director approval and authorization. If an employee is part of the Biological Select Agent and Toxin (BSAT) Program he/she will receive special agent specific vaccination/immunizations (e.g., Smallpox or Anthrax) in accordance with BSAT Occupational Health Program, or as requested by PIs and approved by the Laboratory Director.
- 7.2.2 Hepatitis B Virus (HBV) – When an employee’s job involves possible exposure to blood or other body fluids, they should be vaccinated with the hepatitis B vaccine. Each employee must be informed of his/her right to request this vaccination through their immediate supervisor or the SSO, or may request to waive their vaccination.
 - 7.2.2.1 Prophylactic treatment to prevent HBV infection following accidental cuts and punctures (percutaneous or permucosal) to blood or other body fluids is covered under Section 1.7 of this manual.
- 7.2.3 *Mycobacterium tuberculosis* (TB) Lab - Personnel who work in the TB Lab must have an initial Mantoux tuberculin skin test (TST). This standard method will determine if a person is infected with *Mycobacterium tuberculosis*. TST is also known as the PPD test, because TST is performed by injecting 0.1 ml of tuberculin purified protein derivative (PPD). Employees with a negative PPD are retested annually as part of their employee health policy. If the test becomes positive, the employee must fill out a First Report Form within IWIF packets and contact DHMH TB Control-TB, as drug therapy may be required. The employee must seek medical attention at the State healthcare provider, WorkPro and Occupational Medical Services (OMS), and a follow-up visit with his/her primary care physician is highly recommended. Once an employee’s PPD is positive he/she is no longer required to receive a PPD.
- 7.2.4 Rabies Virus – Vaccination is required prior to employment for all individuals working with the rabies virus or infected animals, or engaged in diagnostic activities with the rabies virus. Upon completion of the rabies vaccination series, the employee must have their antibody titer checked. Rabies titers will be drawn every six (6) months. NO ONE will open animal skulls or perform other rabies laboratory work until he/she expresses an antibody titer to rabies virus.

7.3 General Safety Policies and Practices for Microbiological Laboratories

7.3.1 Containment Principles - The term “containment” is used in describing safe methods for managing infectious agents in the laboratory environment where they are being handled, processed, or maintained. Protection of personnel and the immediate laboratory environment from exposure to infectious agents is achieved through good microbiological technique and the use of appropriate safety equipment.

7.3.1.1 Technique. - The most important element of containment is strict adherence to standard microbiological practices and techniques. It is each **IMMEDIATE SUPERVISOR'S RESPONSIBILITY** to see that employees working under their direction are aware of potential hazards, and are trained and proficient in the practices and techniques required for safely handling infectious materials and agents.

7.3.1.2 Equipment. - Microbiological safety equipment includes biological safety cabinets, a variety of enclosed containers (e.g., safety centrifuge cups), and items for personal protection (**e.g., gloves, lab coats, gowns, and face shields**). **SUPERVISORS MUST** ensure these safety devices are available, function effectively, and employees are trained in the proper use of these devices. **ALL EMPLOYEES** must make proper, routine use of these safety devices.

7.3.1.3 Biological Safety Cabinets - Biological safety cabinets (BSCs) are among the most effective primary containment devices in laboratories working with infectious agents. Class I and II cabinets, when used in conjunction with good microbiological techniques, provide an effective partial containment system for safe manipulation of moderate and high-risk microorganisms (i.e., bio-safety Level 2 and 3 agents). Both Class I and II BSCs have comparable inward face velocities (75 linear ft/min) and provide comparable levels of containment in protecting the lab employee and the immediate lab environment from infectious aerosols generated within the cabinet.

7.3.1.4 Class I BSCs are open-front, negative pressure, ventilated cabinets with a minimum inward face velocity at the work opening of 75 ft./min. The exhaust air is filtered by a High Efficiency Particulate Air (HEPA) filter. Class I cabinets do not use recirculated air. All air entering the cabinet comes directly from outside the cabinet, from ductwork.

7.3.1.5 Class II BSCs differ from Class I cabinets in that they use 80% recirculated air.

7.3.1.6 Class II, type "A" cabinets contain a single fan and internal HEPA filters located above the workspace.

7.3.1.7 Class II, type "B" cabinets contain dual fans and internal HEPA filters located below the workspace.

7.3.1.8 Class I or II BSCs must be tested and certified at the time of installation and then annually, and whenever one is moved.

7.3.2 Operational Requirements

7.3.2.1 Training Requirements - Personnel must be trained in the proper use of BSCs. Contact your supervisor or Division Chief for training information.

7.3.2.2 Do not preform activities that may disrupt the inward directional airflow through the work opening of Class I and II cabinets. Repeated insertion and withdrawal of the employee's arms in and out of the work chamber, opening and closing doors to the lab, improper operation of equipment within the work chamber, or brisk walking past the BSC while it is in use, will cause aerosolized particles to escape from the cabinet.

7.3.2.3 Most materials for a given operation must be placed in the cabinet before work is begun, both to minimize in and out motion, and to permit working in an efficient manner.

7.3.2.4 Class II cabinets - The operator must work well within the cabinet and not close to the front. Substantial leakage from the cabinet can occur when work is being performed within 4 inches of the cabinet opening. This condition is unique to Class II cabinets due to the relatively low inlet air velocities at the top edge of the work opening, and the air removal slot or grill along the front of the work surface of some cabinets.

7.3.2.5 BSC must be decontaminated at the end of each operation or at the end of each workday. Most cabinets of stainless steel or durable plastic will withstand periodic use of a 1:10 dilution of household bleach (500 ppm sodium hypochlorite). However, this disinfectant is corrosive. Other disinfectants, such as 70% ethanol or quaternary ammonium compounds are satisfactory. If a moderate risk agent is handled, such as the hepatitis B virus, wipe down with a 2% iodophor solution, followed by alcohol to remove the iodine.

7.4 Laboratory Biosafety Level Criteria (from: BMBL, 5th Edition, December 2009 revision)

7.4.1 Biosafety Level builds upon BSL-1. BSL-2 is suitable for work involving agents which pose moderate hazards to personnel and the environment. It

differs from BSL-1 in that: 1) laboratory personnel have specific training in handling pathogenic agents and are supervised by scientists competent in handling infectious agents and associated procedures; 2) access to the laboratory is restricted when work is being conducted; and 3) all procedures in which infectious aerosols or splashes may be created are conducted in BSCs or other physical containment equipment. The following standard and special practices, safety equipment, and facility requirements apply to the BSL-2 facilities in the Laboratories Administration:

7.4.1.1 Standard Biosafety Practices

- 7.4.1.1.1 The laboratory supervisor must enforce the institutional policies that control access to the laboratory.
- 7.4.1.1.2 Persons must wash their hands after working with potentially hazardous materials and before leaving the laboratory.
- 7.4.1.1.3 Eating, drinking, smoking, handling contact lenses, applying cosmetics, and storing food for human consumption is not permitted in laboratory areas. Food must be stored outside the laboratory area in designated cabinets and refrigerators.
- 7.4.1.1.4 Mouth pipetting is prohibited; mechanical pipetting devices must be used.
- 7.4.1.1.5 Policies for the safe handling of sharps, such as needles, scalpels, pipettes, and broken glassware, must be developed and implemented. Whenever practical, laboratory supervisors should adopt improved engineering and work practice controls that reduce risk of sharps injuries. Precautions, including those listed below, must always be taken with sharp items. These include:
 - 7.4.1.1.5.1 Careful management of needles and other sharps are of primary importance. Needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal.
 - 7.4.1.1.5.2 Used disposable needles and syringes must be carefully placed in conveniently located puncture-resistant containers used for sharps disposal.

- 7.4.1.1.5.3 Non-disposable sharps must be placed in a hard walled container for transport to a processing area for decontamination, preferably by autoclaving.
- 7.4.1.1.5.4 Broken glassware must not be handled directly. It must be removed using a brush and dustpan, tongs, or forceps. Plasticware should be substituted for glassware whenever possible.
- 7.4.1.1.6 Perform all procedures to minimize the creation of splashes and/or aerosols.
- 7.4.1.1.7 Decontaminate work surfaces after completion of work and after any spill or splash of potentially infectious material with appropriate disinfectant.
- 7.4.1.1.8 Decontaminate all cultures, stocks, and other potentially infectious materials prior to disposal using an effective method. Depending on where the decontamination will be performed, the following methods should be used prior to transport:
 - 7.4.1.1.8.1 Materials to be decontaminated outside of the immediate laboratory must be placed in a durable, leak proof container and secured for transport.
 - 7.4.1.1.8.2 Materials to be removed from the facility for decontamination must be packed in accordance with applicable local, state, and federal regulations.
- 7.4.1.1.9 A sign incorporating the universal biohazard symbol must be posted at the entrance to the BSL-3 laboratory when infectious agents are present. Posted information must include: the BSL-3 definition, required PPE, the PI or supervisor's name (or other responsible personnel), telephone number, and required procedures for entering and exiting the laboratory. Agent information should be posted in accordance with the institutional policy.
- 7.4.1.1.10 An effective integrated pest management program is required. (For additional reference, see Appendix G of the **BMBL, 5th Edition.**)

7.4.1.1.11 The laboratory supervisor must ensure laboratory personnel receive appropriate training regarding their duties, the necessary precautions to prevent exposures, and exposure evaluation procedures. Personnel must receive annual updates or additional training when procedural or policy changes occur. Personal health status may impact an individual's susceptibility to infection, ability to receive immunizations, or prophylactic interventions. All laboratory personnel, and particularly women of childbearing age, should be provided with information regarding immune competence and conditions that may predispose them to infection. Individuals having these conditions should be encouraged to self-identify to the institution's healthcare provider for appropriate counseling and guidance.

7.4.1.2 Special Practices

- 7.4.1.2.1 All persons entering the laboratory must be advised of the potential hazards and meet specific entry/exit requirements.
- 7.4.1.2.2 Laboratory personnel must be provided medical surveillance, as appropriate, and offered available immunizations for agents handled or potentially present in the laboratory.
- 7.4.1.2.3 Each institution should consider the need for collection and storage of serum samples from at-risk personnel.
- 7.4.1.2.4 A laboratory-specific biosafety manual must be prepared and adopted as policy. The biosafety manual must be available and accessible.
- 7.4.1.2.5 The laboratory supervisor must ensure that laboratory personnel demonstrate proficiency in standard and special microbiological practices before working with BSL-2 agents.
- 7.4.1.2.6 All potentially infectious materials must be placed in a durable, leak proof container during collection, handling, processing, storage, or transport within a facility.
- 7.4.1.2.7 Laboratory equipment should be routinely decontaminated, including after spills, splashes, or other potential contamination has occurred.

7.4.1.2.7.1 Spills involving infectious materials must be contained, decontaminated, and cleaned up by staff properly trained and equipped to work with infectious material.

7.4.1.2.7.2 Equipment must be decontaminated before repair, maintenance, or removal from the laboratory.

7.4.1.2.8 Incidents that may result in exposure to infectious materials must be immediately evaluated and treated according to procedures described in the laboratory safety manual. All such incidents must be reported to the laboratory supervisor and SSO. Medical evaluation, surveillance, and treatment should be provided and appropriate records maintained.

7.4.1.2.9 Animal and plants not associated with the work being performed must not be permitted in the laboratory.

7.4.1.2.10 All procedures involving the manipulation of infectious materials that may generate an aerosol should be conducted within a BSC or other physical containment device.

7.4.1.3 Safety Equipment (Primary Barriers and Personal Protective Equipment)

7.4.1.3.1 Properly maintained BSCs, other appropriate personal protective equipment, or other physical containment devices must be used whenever:

7.4.1.3.1.1 Procedures with a potential for creating infectious aerosols or splashes are conducted. These may include pipetting, centrifuging, grinding, blending, shaking, mixing, sonicating, opening containers of infectious materials, inoculating animals intranasally, and harvesting infected tissues from animals or eggs.

7.4.1.3.1.2 When high concentrations or large volumes of infectious agents are used, such materials may be centrifuged in the open laboratory using sealed rotor heads or centrifuge safety cups.

7.4.1.3.2 Protective lab coats, gowns, smocks, or uniforms designated for laboratory use must be worn while working with hazardous materials. Remove protective clothing

before leaving for non-laboratory areas, (e.g., hallway, elevator #1 and #2, lunch room, break rooms, library, and administrative offices). Dispose of protective clothing appropriately, or deposit for laundering by the institution. Laboratory clothing should not be taken home.

7.4.1.3.3 Eye and face protection (goggles, mask, face shield or other splatter guard) must be worn while employees enter all laboratory work areas (including write-up areas). Eye and face protection must be disposed of with other contaminated laboratory waste or decontaminated before reuse. Persons who wear glasses should also wear eye protection.

7.4.1.3.4 Gloves must be worn to protect hands from exposure to hazardous materials. Glove selection should be based on an appropriate risk assessment. Alternatives to latex gloves should be available. Gloves must not be worn in write-up areas or outside the laboratory. In addition, BSL-2 laboratory workers should:

7.4.1.3.4.1 Change gloves when contaminated, glove integrity is compromised, or when otherwise necessary.

7.4.1.3.4.2 Remove gloves and wash hands when work with hazardous materials has been completed and before leaving the laboratory.

7.4.1.3.4.3 Do not wash or reuse disposable gloves. Dispose of used gloves with other contaminated laboratory waste. Hand washing protocols must be rigorously followed.

7.4.1.3.5 Eye, face and respiratory protection should be used in rooms containing infected animals as determined by the risk assessment.

7.4.1.4 Laboratory Facilities (Secondary Barriers)

7.4.1.4.1 Laboratory doors should be self-closing and have locks in accordance with the institutional policies.

7.4.1.4.2 Laboratories must have a sink for hand washing. The sink may be manual, hands-free, or automatically operated. It

should be located near the exit door.

- 7.4.1.4.3 The laboratory should be designed so it can be easily cleaned and decontaminated. Carpets and rugs in laboratories are not permitted.
- 7.4.1.4.4 Laboratory furniture must be capable of supporting anticipated loads and uses. Spaces between benches, cabinets, and equipment should be accessible for cleaning.
 - 7.4.1.4.4.1 Bench tops must be impervious to water and resistant to heat, organic solvents, acids, alkalis, and other chemicals.
 - 7.4.1.4.4.2 Chairs used in laboratory work must be covered with a non-porous material that can be easily cleaned and decontaminated with appropriate disinfectant.
- 7.4.1.4.5 BSCs must be installed so that fluctuations of the room air supply and exhaust do not interfere with proper operations. BSCs should be located away from doors, windows that can be opened, heavily traveled laboratory areas, and other possible airflow disruptions.
- 7.4.1.4.6 Vacuum lines should be protected with liquid disinfectant traps.
- 7.4.1.4.7 An eyewash station must be readily available.
- 7.4.1.4.8 There are no specific requirements for ventilation systems. However, planning of new facilities should consider mechanical ventilation systems that provide an inward flow of air without recirculation to spaces outside of the laboratory.
- 7.4.1.4.9 HEPA filtered exhaust air from a Class II BSC can be safely re-circulated into the laboratory environment if the cabinet is tested and certified annually, and operated according to the manufacturer's recommendations. BSCs can also be connected to the laboratory exhaust system by either a thimble (canopy) connection or directed to the outside through a hard connection. Provisions to assure proper safety cabinet performance and air system operation must be verified.

- 7.4.1.4.10 A method for decontaminating all laboratory waste should be available in the facility (e.g., autoclave, chemical disinfection, incineration, or other validated decontamination method).

7.4.2 Biosafety Level -3 (BSL-3)

BSL-3 is applicable to clinical, diagnostic, teaching, research, or production facilities where work is performed with indigenous or exotic agents that may cause serious or potentially lethal disease through the inhalation route of exposure. BSL-3 areas have restricted access. Laboratory personnel must receive specific training in handling pathogenic and potentially lethal agents, and must be supervised by scientists competent in handling infectious agents and associated procedures.

All procedures involving the manipulation of infectious materials must be conducted within BSCs or other physical containment devices.

A BSL-3 laboratory has special engineering and design features. The Laboratories Administration has 17,500 sq. ft. of BSL-3 lab space used strictly for diagnostic testing.

The following standard and special safety practices, equipment, and facility requirements apply to the BSL-3 facilities in the Laboratories Administration, for additional information please refer to the current BSL-3 Standard Operational Procedure:

7.4.2.1 Standard Biosafety Practices for BSL-3

- 7.4.2.1.1 Laboratory supervisors must enforce the institutional policies controlling access to the BSL-3 laboratory.
- 7.4.2.1.2 Persons must wash their hands after working with potentially hazardous materials and before leaving the laboratory.
- 7.4.2.1.3 Eating, drinking, smoking, handling contact lenses, applying cosmetics, and storing food for human consumption must not be permitted in laboratory areas. Food must be stored outside the laboratory area in designated cabinets and refrigerators.
- 7.4.2.1.4 Mouth pipetting is prohibited; mechanical pipetting devices must be used.
- 7.4.2.1.5 Policies for the safe handling of sharps, such as needles,

scalpels, pipettes, and broken glassware must be developed and implemented. Whenever practical, laboratory supervisors should adopt improved engineering and work practice controls that reduce risk of sharps injuries.

- 7.4.2.1.6 Precautions, including those listed below, must always be taken with sharp items. These include:
 - 7.4.2.1.6.1 Careful management of needles and other sharps are of primary importance. Needles must not be bent, sheared, broken, recapped, removed from disposable syringes, or otherwise manipulated by hand before disposal.
 - 7.4.2.1.6.2 Used disposable needles and syringes must be carefully placed in conveniently located puncture-resistant containers used for sharps disposal.
 - 7.4.2.1.6.3 Non-disposable sharps must be placed in a hard walled container for transport to a processing area for decontamination, preferably by autoclaving.
 - 7.4.2.1.6.4 Broken glassware must not be handled directly. Instead, it must be removed using a brush and dustpan, tongs, or forceps. Plasticware should be substituted for glassware whenever possible.
- 7.4.2.1.7 Perform all procedures to minimize the creation of splashes and/or aerosols.
- 7.4.2.1.8 Decontaminate work surfaces after completion of work and after any spill or splash of potentially infectious material with appropriate disinfectant.
 - 7.4.2.1.8.1 BSL-3 lab space must decontaminate after any spill or lab accident that may result in a possible. Routine BSL-3 lab space decontamination should be performed as part of the SOP. Refer to Biosafety Level 3-Standard Operating Procedure, and Bioquell Decon Standard Operating Procedure.
- 7.4.2.1.9 Decontaminate all cultures, stocks, and other potentially infectious materials prior to disposal using an effective method. A method for decontaminating all laboratory

waste should be available in the facility, preferably within the laboratory (e.g., autoclave, chemical disinfection, incineration, or other validated decontamination method). Depending on where the decontamination will be performed, the following methods should be used prior to transport:

7.4.2.1.9.1 Materials to be decontaminated outside of the immediate laboratory must be placed in a durable, leak proof container and secured for transport.

7.4.2.1.9.2 Materials to be removed from the facility for decontamination must be packed in accordance with applicable local, state, and federal regulations.

7.4.2.1.10 A sign incorporating the universal biohazard symbol must be posted at the entrance to the laboratory when infectious agents are present. Posted information must include the laboratory's biosafety level, the supervisor's name (or other responsible personnel), telephone number, and required procedures for entering and exiting the laboratory. Agent information should be posted in accordance with the institutional policy.

7.4.2.1.11 An effective integrated pest management program is required (for additional reference, see Appendix G of the **BMBL, 5th Edition**.).

7.4.2.1.12 The laboratory supervisor must ensure that laboratory personnel receive appropriate training regarding their duties, the necessary precautions to prevent exposures, and exposure evaluation procedures. Personnel must receive annual updates or additional training when procedural or policy changes occur. Personal health status may impact an individual's susceptibility to infection, ability to receive immunizations or prophylactic interventions. All laboratory personnel, particularly women of childbearing age, should be provided with information regarding immune competence and conditions that may predispose them to infection. Individuals having these conditions should be encouraged to self-identify to the institution's healthcare provider for appropriate counseling and guidance.

7.4.2.2 Special Practices

- 7.4.2.2.1 All persons entering the laboratory must be advised of the potential hazards and meet specific entry/exit requirements.
- 7.4.2.2.2 Laboratory personnel must be provided medical surveillance and offered appropriate immunizations for agents handled or potentially present in the laboratory.
- 7.4.2.2.3 Each institution should consider the need for collection and storage of serum samples from at-risk personnel.
- 7.4.2.2.4 A laboratory-specific biosafety manual must be prepared and adopted as policy. The biosafety manual must be available and accessible.
- 7.4.2.2.5 The laboratory supervisor must ensure laboratory personnel demonstrate proficiency in standard and special microbiological practices before working with BSL-3 agents.
- 7.4.2.2.6 Potentially infectious materials must be placed in a durable, leak proof container during collection, handling, processing, storage, or transport within a facility.
- 7.4.2.2.7 Laboratory equipment should be routinely decontaminated, including after spills, splashes, or other potential contamination have occurred.
 - 7.4.2.2.7.1 Spills involving infectious materials must be contained, decontaminated, and cleaned up by staff properly trained and equipped to work with infectious material.
 - 7.4.2.2.7.2 Equipment must be decontaminated before repair, maintenance, or removal from the laboratory.
- 7.4.2.2.8 Incidents resulting in exposure to infectious materials must be immediately evaluated and treated according to procedures described in the laboratory biosafety manual. All such incidents must be reported to the laboratory supervisor. Medical evaluation, surveillance, and treatment should be provided and appropriate records maintained.
- 7.4.2.2.9 Animals and plants not associated with the work being

performed are not permitted in the laboratory.

- 7.4.2.2.10 All procedures involving the manipulation of infectious materials must be conducted within a BSC, or other physical containment devices. No work with open vessels is conducted on the bench. When a procedure cannot be performed within a BSC, a combination of personal protective equipment and other containment devices, such as a centrifuge safety cup or a sealed rotor, must be used.

7.4.2.3 Safety Equipment (Primary Barriers and Personal Protective Equipment)

- 7.4.2.3.1 All procedures involving the manipulation of infectious materials must be conducted within a BSC (preferably Class II or Class III), or other physical containment device.
- 7.4.2.3.2 Workers in the laboratory should wear protective laboratory clothing with a solid-front, such as tie-back or wrap-around gowns, scrub suits, or coveralls. Protective clothing is prohibited outside of the laboratory. Reusable clothing should be decontaminated prior to being laundered. Clothing should be changed when contaminated.
- 7.4.2.3.3 Eye and face protection (goggles, mask, face shield or other splash guard) should be used for anticipated splashes or sprays of infectious or other hazardous materials. Eye and face protection must be disposed of with other contaminated laboratory waste or decontaminated before reuse. Persons who wear contact lenses in laboratories must also wear eye protection.
- 7.4.2.3.4 Gloves must be worn to protect hands from exposure to hazardous materials. Glove selection should be based on an appropriate risk assessment, and alternatives to latex gloves should be available. Gloves are prohibited to be worn outside the laboratory. In addition, BSL-3 laboratory workers should:
 - 7.4.2.3.4.1 Change gloves when contaminated, glove integrity is compromised, or when otherwise necessary. Wear two pairs of gloves when appropriate.
 - 7.4.2.3.4.2 Remove gloves and wash hands when work

with hazardous materials has been completed and before leaving the laboratory.

7.4.2.3.4.3 Do not wash or reuse disposable gloves.

Dispose of used gloves with other contaminated laboratory waste. Hand washing protocols must be rigorously followed.

7.4.2.3.5 Eye, face, and respiratory protection must be used in rooms containing infected animals.

7.4.2.4 Laboratory Facilities (Secondary Barriers)

7.4.2.4.1 Laboratory doors must be self-closing and have locks in accordance with the institutional policies. The laboratory must be separated from areas that are open to unrestricted traffic flow within the building. Laboratory access is restricted, and access to the laboratory is through two self-closing doors. A clothing change room (anteroom) may be included in the passageway between the two self-closing doors.

7.4.2.4.2 Laboratories must have a sink for hand washing. The sink must be hands-free or automatically operated, and located near the exit. If the laboratory is segregated into different laboratories, a sink must be available for hand washing in each zone. Additional sinks may be required as determined by the risk assessment.

7.4.2.4.3 The laboratory must be designed to be easily cleaned and decontaminated. Carpets and rugs are not permitted. Seams, floors, walls, and ceiling surfaces should be sealed. Spaces around doors and ventilation openings should be capable of being sealed to facilitate space decontamination.

7.4.2.4.3.1 Floors must be slip resistant, impervious to liquids, and resistant to chemicals. Consideration should be given to the installation of seamless, sealed, resilient or poured floors, with integral cove bases.

7.4.2.4.3.2 Walls should be constructed to produce a sealed smooth finish and be easily cleaned and decontaminated.

7.4.2.4.3.3 Ceilings should be constructed, sealed, and

finished in the same general manner as walls.

- 7.4.2.4.4 Decontamination of the entire laboratory should be considered when gross contamination of the space, significant changes in laboratory usage, major renovations, or maintenance shut downs have occurred. Selection of the appropriate materials and methods used to decontaminate the laboratory must be based on the risk assessment.
- 7.4.2.4.5 Laboratory furniture must be capable of supporting anticipated loads and uses. Spaces between benches, cabinets, and equipment must be accessible for cleaning.
 - 7.4.2.4.5.1 Bench tops must be impervious to water and resistant to heat, organic solvents, acids, alkalis, and other chemicals.
 - 7.4.2.4.5.2 Chairs used in laboratory work must be covered with a non-porous material that can be easily cleaned and decontaminated with appropriate disinfectant.
- 7.4.2.4.6 All windows in the laboratory must be sealed.
- 7.4.2.4.7 BSCs must be installed so that fluctuations of the room air supply and exhaust do not interfere with proper operations. BSCs should be located away from doors, heavily traveled laboratory areas, and other possible airflow disruptions.
- 7.4.2.4.8 Vacuum lines must be protected with HEPA filters, or their equivalent, and replaced as needed. Liquid disinfectant traps may be required.
- 7.4.2.4.9 An eyewash station must be readily available in the laboratory.
- 7.4.2.4.10 An air duct ventilation system is required. This system must provide sustained directional airflow by drawing air into the laboratory from “clean” areas toward “potentially contaminated” areas. The laboratory shall be designed so airflow will not be reversed under failure conditions.
 - 7.4.2.4.10.1 Laboratory personnel must be able to verify directional airflow. A visual monitoring device, which confirms directional airflow, must be provided at the laboratory entry.

Audible alarms should be considered to notify personnel of air flow disruption.

- 7.4.2.4.10.2 The laboratory exhaust air must not re-circulate to any other area of the building.
- 7.4.2.4.10.3 The laboratory building exhaust air should be dispersed away from occupied areas and from building air intake locations, or be directed through a HEPA filter.
- 7.4.2.4.10.4 HEPA filter housings should have gas-tight isolation dampers, decontamination ports, and/or bag-in/bag-out (with appropriate decontamination procedures) capability. The HEPA filter housing should allow for leak testing of each filter and assembly. The filters and the housing should be certified annually.
- 7.4.2.4.11 HEPA filtered exhaust air from a Class II BSC can be safely re-circulated into the laboratory environment if the cabinet is tested and certified at annually, and operated according to the manufacturer's recommendations. BSCs can also be connected to the laboratory exhaust system by either a thimble (canopy) connection or directed to the outside through a hard connection. Provisions to assure proper safety cabinet performance and air system operation must be verified. BSCs should be certified annually to assure correct performance. Class III BSCs must be directly (hard) connected through the second exhaust HEPA filter of the cabinet. Supply air must be provided in such a manner to prevent positive pressurization of the cabinet.
- 7.4.2.4.12 A method for decontaminating all laboratory waste should be available in the facility, preferably within the laboratory (e.g., autoclave, chemical disinfection, or other validated decontamination method).
- 7.4.2.4.13 Equipment producing infectious aerosols must be contained in primary barrier devices that exhaust air through HEPA filtration or other equivalent technology before being discharged into the laboratory. These HEPA filters should be tested and/or replaced at least annually.
- 7.4.2.4.14 Equipment must be deconed prior to removing it from the

lab space.

7.4.2.4.15 Enhanced environmental and personal protection may be required by the agent summary statement, risk assessment, or applicable local, state, or federal regulations. These laboratory enhancements may include one or more of the following: an anteroom for clean storage of equipment and supplies with dress-in, shower-out capabilities; gas tight dampers to facilitate laboratory isolation; final HEPA filtration of the laboratory exhaust air; laboratory effluent decontamination; and advanced access control devices, such as biometrics.

7.4.2.4.16 The BSL-3 facility design, operational parameters, and procedures must be verified and documented prior to operation. Facilities must be re-verified and documented annually.

7.5 Universal Precautions for Laboratories

Blood and other body fluids from **ALL** patients should be considered infectious. **The following precautions are required for employees in laboratories engaging in the handling, processing, testing, or disposing of ALL biological specimens:**

- 7.5.1 All employees must routinely use appropriate barrier precautions, as designed by the manufacturer, to prevent skin and mucous membrane exposure when contact with blood or other body fluids is anticipated. Lab coats and gloves must be worn when touching blood and body fluids, mucous membranes, or non-intact skin of all patients, for handling items or surfaces soiled with blood or body fluids, and for performing venipuncture and other vascular access procedures. Gloves must be changed after contact with each patient. To prevent exposure of mucous membranes of the mouth, nose and eyes, masks and protective eyewear or face shields must be worn during procedures likely to generate droplets of blood or other body fluids.
- 7.5.2 Hands and other skin surfaces must be washed immediately and thoroughly if contaminated with blood or other body fluids, and after gloves are removed.
- 7.5.3 All specimens of blood and body fluids must be placed in a well constructed container with a secure lid to prevent leaking during transport (i.e., BioTransport Container). Care should be taken when collecting each specimen to avoid contaminating the outside of the container and the laboratory form accompanying the specimen.
- 7.5.4 For routine procedures, such as histologic and pathologic studies or microbiologic culturing, a biological safety cabinet is not necessary. Biological

safety cabinets (Class I or II) should be used whenever procedures are conducted having a high potential for generating droplets. These include activities such as blending, some pipetting, sonicating, vigorous mixing, and inoculation of laboratory animals.

- 7.5.5 Mechanical pipetting devices should be used for manipulating all liquids in the laboratory. Mouth pipetting is strictly forbidden.
- 7.5.6 All employees must take precautions to prevent injuries caused by needles, scalpels and other sharp instruments or devices during procedures; when cleaning used instruments; during disposal of used needles; and when handling sharp instruments. To prevent needle stick injuries, needles are not to be recapped, purposely bent or broken by hand, removed from disposable syringes, or otherwise manipulated by hand. After they are used, disposable syringes and needles, scalpel blades, and other sharp items must be placed in rigid sharps containers for disposal; these rigid sharps containers should be located as close as practical to the use area. Large-bore reusable needles must be placed in a puncture-resistant container for transport to the reprocessing area. NEVER fill container more than $\frac{3}{4}$ full.
- 7.5.7 Laboratory work surfaces must be decontaminated with an appropriate chemical germicide after a spill of blood or other body fluids and when work activities are completed.
- 7.5.8 Contaminated materials used in laboratory tests must be decontaminated before reprocessing.
- 7.5.9 Scientific equipment contaminated with blood or other body fluids must be decontaminated and cleaned before being repaired in the laboratory or transported to the manufacturer.
- 7.5.10 All personnel must wash their hands after completing laboratory activities and must remove protective clothing before leaving the technical area.

7.6 Disinfecting

Disinfection of items contaminated by bio-hazardous agents is an important part of protecting laboratory employees from infectious disease.

- 7.6.1 The term "disinfection" implies the use of liquid antimicrobial chemicals on inanimate objects (workbenches, floors, glassware, equipment, etc.) with the objective of destroying nearly all organisms of potential hazard to humans. **(Disinfection should not be confused with sterilization, which implies total destruction of all microorganisms.)**

- 7.6.2 Although the use of disinfectants is necessary and routine, employees must

remember that disinfectants have properties that can also make them dangerous. The undesirable properties can, in most cases, be mitigated by common sense precautions.

- 7.6.3 All laboratory work surfaces should be disinfected prior to starting work, and at the end of each day. A container of ready use disinfectant (i.e., 1:10 bleach dilution) must be kept in all areas where infectious material is handled.

- 7.6.3.1 Skin irritation (iodophors, bleach), burns and contact dermatitis (isopropyl alcohol, glutaraldehyde, quaternary ammonium compounds) can be prevented by wearing appropriate gloves.

- 7.6.3.2 Using recommended formulations for disinfectants prevents the formation of toxic fumes upon autoclaving.

7.6.4 Most Commonly Used Disinfectants

- 7.6.4.1 Bleach - A 1:10 dilution of household bleach is an appropriate disinfectant for routine use. It is prepared by adding 1 part bleach to 9 parts tap water. This solution loses its free chlorine overnight, therefore, a fresh batch must be mixed daily.

- 7.6.4.1.1 Activate™ Bleach Dilution System, Deardorff Fitzsimmons, is another bleach disinfectant. Activate™ automatically dilutes and dispenses EPA registered sodium hypochlorite, bleach, in a 5,000 ppm 5.25% solution.

- 7.6.4.2 Lysol – The second most common disinfectant used is Lysol, made according to the manufacturer's specifications.

- 7.6.4.3 LopHene- The third most common phenolic germicidal disinfectant is LopHene, using a daily made 0.04 % LopHene and water solution.

- 7.6.4.3.1 CiDeon® is another concentrated phenolic disinfectant is a high pH (alkaline) germicidal disinfectant is made daily 0.05% CiDeon® and water solution.

7.7 Autoclave Safety

- 7.7.1 All Laboratories Administration employees shall abide by their Divisional Autoclave procedures and operational guidelines.

- 7.7.1.1 Select agent and BSL-3 autoclaving procedures are located in the Office of Laboratory Emergency Preparedness and Response (OLEPR) and BSL-3 Labs.

- 7.7.2 **NO EMPLOYEE** may operate an autoclave without first receiving adequate training and approval from their immediate supervisor.
- 7.7.3 Laboratory employees depend daily upon proper autoclaving (i.e., sterilization using saturated steam under pressure) as a chief means of protecting themselves, supplies, equipment and the work environment from contamination by infectious microorganisms.
- 7.7.4 **NOTE:** For more information concerning autoclaving see the Prep Lab's Standard Operating Procedure (SOP). The document can be found in the Divisional Office of Environmental Microbiology.

8.0 WASTE DISPOSAL

8.1 Infectious Waste Disposal

The procedures outlined in this subsection apply only to potentially infectious contaminated wastes. Noninfectious glass, sharps, chemical and radioactive wastes are covered in a separate sub-section.

8.1.1 Liquid Biohazardous Infectious Waste

8.1.1.1 Sinks and drains are not to be used for disposal of infectious materials.

8.1.1.2 Infectious liquid wastes leaving the laboratory must be either decontaminated before removal or transported under controlled conditions to a service area for treatment.

8.1.1.3 Discard pans on workbenches must contain an approved disinfectant at a concentration, which, even after addition of liquids, will ensure disinfecting activity.

8.1.1.4 Liquid infectious wastes must be sterilized using steam autoclaves. After autoclaving, liquid wastes (e.g., spent cell culture media, fermentation broth, and previously contaminated water) may be poured down drains emptying into a sanitary sewer.

8.1.1.5 Any disinfectant used on materials, which will be later autoclaved, should be of a type that will not produce toxic fumes when heated.

8.1.2 Solid Biohazardous Infectious Wastes or Special Medical Waste

8.1.2.1 Solid infectious waste can include used glassware, used plastic ware, and refuse (e.g., paper, absorbent pads, animal carcasses, and lab specimens).

8.1.2.2 Reusable glassware and plasticware should be placed in pans containing disinfectant solution or in autoclave cans lined with a biohazardous waste bag as described in this manual. Place contaminated pipettes horizontally in discard pans so disinfectant will cover the pipettes. Pans and cans must be autoclaved before the glass or plastic ware can be washed.

8.1.2.3 Contaminated biohazardous waste should be collected in disposable, plastic biohazard bags. Contaminated biohazardous waste must be either process using the tissue digester (e.g., animal carcasses) autoclaved (e.g., paper, lab specimens), or placed in biohazard bags before being placed in an approved disposal container. Animal carcasses must be processed using the tissue digester, located in Rm LL-45 and any remains (e.g., bones) must be place in biohazard bag for disposal.

8.1.2.4 Following proper autoclaving, solid waste is no longer infectious and can be placed in regular black plastic bags for disposal in a landfill. **NO** decontaminated orange biohazard bags may be tossed into a dumpster without first being placed inside a dark plastic bag.

8.1.3 Radioactive Infectious Waste

When disposing of radioactive biohazardous materials, always consult the RSO and SSO before initiating any decontamination procedure. When dealing with radioisotopes, routine decontamination procedures may require modification.

8.1.3.1 The RSO must evaluate the potential hazard of radioactivity release before a steam autoclave can be used. The most likely type of radiation hazard will be either ^{14}C or ^3H , and usually either can be autoclaved without hazard.

8.1.3.2 The activity of ^{125}I may be sufficient to preclude autoclaving. In such a case, the biohazardous agent may have to be inactivated using a compatible liquid chemical germicide before the waste is packaged as a radioactive waste. **DO NOT** use household bleach (sodium hypochlorite) as the liquid germicide. I_2 could be released through the chemical reaction. Glutaraldehyde is a suitable substitute. The infection potential is considered more hazardous than the low level of radioactivity.

8.2 Chemical Waste Disposal

8.2.1 The disposal of chemical wastes from analytical laboratories is not a casual

affair. **ANY** unwanted chemical or chemical waste should be considered a potentially hazardous waste and handled as such. Strict laws govern the disposal of “controlled hazardous” substances (CHS). The Laboratories Administration must comply with the regulations in COMAR 26.13. These regulations are substantially equivalent to the Federal EPA administered program authorized under the Resource Conservation and Recovery Act (RCRA), 42 USC 6901 et. seq. Violation of these regulations subjects the violator to heavy criminal penalties. The regulations spell out in detail the characteristics of hazardous waste. In cases when the hazardous nature of the chemical waste is unknown, questions concerning disposal should be referred to the SSO/Chemical Hygiene Officer. Refer to the current Chemical Hygiene Plan.

8.2.2 General Principles of Chemical Waste Disposal

8.2.2.1 The SSO, the Chemical Hygiene Officer, or the hazardous waste coordinator must review each disposal list to determine those wastes requiring handling according to provisions of the hazardous waste laws.

8.2.2.2 No hazardous material may be put down a drain leading to the sewer system or into the routine trash collection system.

8.2.2.3 Excess, outdated or otherwise unwanted chemicals in their original containers should be retained in the unit until arrangements for their removal have been made through the SSO/Chemical Hygiene Officer.

8.2.2.4 Waste chemicals generated as part of laboratory testing procedures must be collected in suitable, properly labeled and dated containers. All constituents and their approximate percent composition should be noted on the labels. Pick-up and disposal of these wastes must be arranged through the SSO/Chemical Hygiene Officer.

8.2.2.5 Chemical wastes generated from laboratory instrumentation not exceeding allowable quantities of the substances stated in the hazardous waste list may be routed directly into the sanitary sewer. Waste streams which are merely acidic or basic may be discharged into the sanitary sewer if they do not produce a resulting effluent with a pH >10 or <6.

8.2.2.6 All other chemical waste problems should be referred to the SSO/Chemical Hygiene Officer for evaluation and recommendation.

8.3 Waste Management Program

8.3.1 Proper selection of analytic methods and procedures, and scheduling of

operations to minimize production of hazardous chemical wastes.

8.3.2 Ordering and stocking chemical supplies in quantities to be used within expiration dates; having dependable vendor sources from which emergency supplies can be obtained without having to overstock.

8.3.3 Proper labeling and storing of all chemicals in appropriate containers regardless of whether the chemicals are stocked on a shelf or in use.

8.3.4 Coordinating all chemical waste disposal through the SSO/Chemical Hygiene Officer so it is handled in a legally and environmentally acceptable manner.

8.4 Procedures for Disposing of Chemical Wastes and Unwanted Chemicals

8.4.1 Lab Units and Sections - The unit or section supervisor must provide a list of all materials requiring disposal to the SSO, using the “Generator’s Inventory of Hazardous Waste Submitted for Removal” Form (Appendix F, Chemical Hygiene Plan). The form includes the following items:

8.4.1.1 Generators name and date

8.4.1.2 Room Number

8.4.1.3 Chemical name and description

8.4.1.4 Units (container size and volume)

8.4.1.5 Quantity

NOTE: All waste stored in a non-original container must have a “Material Profile Sheet” prepared. The SSO must prepare this sheet based on information and analyses provided by the generating laboratory.

8.5 Glassware

- 8.5.1 Decontaminate all glassware exposed to potentially infectious specimens or microorganisms before washing or discarding.
- 8.5.2 Dispose of clean or decontaminated broken or discarded glass and glassware in a separate, specially marked container. Disposal of glass along with routine paper and other trash poses a hazard to the custodial staff.

8.6 Needles, Syringes and Other Sharps

- 8.6.1 SOPs requiring needles and syringes should be continuously evaluated for other safer alternatives (i.e., pipettes).
- 8.6.2 To prevent needle stick injuries, needles are not to be recapped, purposely bent, or broken by hand, removed from disposable syringes, or otherwise manipulated by hand.
- 8.6.3 Place all used disposable syringes and needles, scalpel blades, and other sharp items in a puncture-proof, leak-proof, disposable, biohazard-labeled container. Wear appropriate protective gloves.
- 8.6.4 Dispose of containers when they are 3/4 full. Never attempt to stuff a full container.
- 8.6.5 Phlebotomists must carry both a needle and syringe disposal container and a biohazard spill kit (paper towels, extra gloves, 5% household bleach and a biohazard bag) with them when drawing blood outside the laboratory.

9.0 SPECIMEN RECEIPT, ACCESSIONING, and PREPARATION AREAS

- 9.1 Employees in these three sections handle and process the same specimens and samples as do employees who perform the actual laboratory testing. Employees in these areas must be familiar with all sections of this manual. Employees must be given training by their supervisors on all potential damages of the materials they are handling and the precautions they must take to avoid injury or exposure to infection.

10.0 GENERAL OFFICE SAFETY

10.1 Clerical and Administrative Area Hazards

There are certain safety precautions and requirements that apply to office and conference areas within the Laboratories Administration.

10.1.1 Biological Hazards

- 10.1.1.1 Specimens are not to be accessioned or processed in any office, data entry room, conference area, or lunchroom.
- 10.1.1.2 When an unwrapped (unbagged) specimen or sample is inadvertently delivered or placed on an office desk, take the necessary precautions to decontaminate the desk.
- 10.1.1.3 Do not store food in refrigerators where clinical specimens or environmental samples are placed.
- 10.1.1.4 **DO NOT** eat or drink in areas where specimens or samples are processed or tested.

10.1.2 Physical Hazards

- 10.1.2.1 Maintain good housekeeping. Do not block aisles, hallways, or exit routes with equipment, furniture or supplies.
- 10.1.2.2 Ensure all air vents are not blocked and are kept free of books, plants, etc.
- 10.1.2.3 Photocopy machine inks, toners, and other fluids may be toxic. Operators must wear gloves when working with or replacing these items.
- 10.1.2.4 Minimize the use of extension cords and don't allow them to lie across walking areas.
- 10.1.2.5 Never attempt to repair any electrical office equipment.
- 10.1.2.6 Only operate equipment you have been trained and authorized to use.
- 10.1.2.7 Report all defective equipment and furniture to your supervisor.
- 10.1.2.8 Do not lift or carry loads that are too heavy, that obstruct your view, or without a prepared place to set them down. Acquire

assistance before moving heavy objects.

- 10.1.2.9 Report all injuries including paper cuts to your immediate supervisor.
- 10.1.2.10 Do not open file or desk drawers above or behind someone without giving them warning.
- 10.1.2.11 Open only one file drawer at a time to prevent the accidental tilting of the cabinet.
- 10.1.2.12 Small break room appliances such as coffee makers, toasters, and toaster ovens, must be turned off and unplugged at the end of each workday. **HOT PLATES AND SPACE HEATERS ARE STRICTLY PROHIBITED.**
- 10.1.2.13 Do not store food in desks or cabinets. Such storage attracts insects and rodents. Sugar, cookies, etc. may only be kept in tightly closed tin cans.
- 10.1.2.14 When attempting to sit onto a chair with wheels, ensure the chair is directly behind you before sitting. Gripping the chair seat base with one hand and pulling the chair under you while getting into the position may prevent the chair from rolling.

10.2 Security Hazards

- 10.2.1 Be familiar with the emergency phone numbers listed on **page ix** of this manual.
- 10.2.2 Do not leave valuables unattended, sitting on desks, or in unlocked desk drawers.
- 10.2.3 See that all sensitive reports, lab slips, patient test results, personnel records, etc. are not left out for public perusal.

11.0 MAINTENANCE SHOP AND WAREHOUSE SAFETY

- 11.1 Maintenance Shop and Warehouse employees in the Laboratories Administration are not only subject to all the physical hazards associated with their profession, but also to all biological and chemical hazards found in a large public health laboratory. Maintenance Shop employees should familiarize themselves with all sections of this manual.
- 11.2 Physical Hazards - Maintenance employees in the Laboratories Administration must possess, and refer to the "Baltimore State Office Complex Fire and Safety Manual,"

“Facility Operations Protocol Manual,” and Corrigo System SOP for a full list of applicable precautions and State safety policies. Several important policies are detailed below:

- 11.2.1 PPE – protective clothing, devices for eyes, face, head, and extremities, must be worn whenever hazardous conditions exist. When required to work in an unfamiliar or unknown environment, maintenance staff should ask the responsible persons familiar with the situation about any possible hazards.
- 11.2.2 Eye and face protection must be worn when there is a reasonable probability of injury by falling or flying objects, glare, UV light, liquids, radiation, infectious agents, or toxic substances.
- 11.2.3 Approved respirators must be worn when exposed contaminated air caused by harmful dusts, fogs, fumes, mists, gases, smokes, sprays, or vapors. Appropriate training is mandatory before using respirators. See the SSO for information on training.
- 11.3 When operating machinery (woodworking, drill presses, fork lift etc.) check to ensure all guards have been installed and are in proper working order.
 - 11.3.1 All fans must be provided with guards.
 - 11.3.2 All machinery designed for a fixed location must be securely anchored to prevent walking or moving.
 - 11.3.3 Fork lift operation requires OSHA certified training. Contact supervisor or SSO regarding training.
- 11.4 Ladders
 - 11.4.1 If a ladder is found to be defective, it must be immediately withdrawn from service and tagged, **DANGEROUS - DO NOT USE!**
 - 11.4.2 Only one person at a time is permitted on any ladder.
 - 11.4.3 Doors must be blocked, locked, or guarded if ladders are to be used in front of door openings.
 - 11.4.4 Never use the top of a ladder as a step.
- 11.5 Lifting or Carrying Materials
 - 11.5.1 Lifting and carrying something improperly accounts for approximately 23% of all employee injuries. When lifting:

11.5.1.1 Size up the job first and plan it properly.

11.5.1.2 Inspect the load.

11.5.2 Learn to lift correctly by following these steps:

11.5.2.1 Plant your feet firmly and comfortably.

11.5.2.2 Squat down and acquire a solid grip.

11.5.2.3 Lift slowly (without jerking) by pushing up with your legs. Keep your back as straight as possible.

11.5.2.4 When you turn, shift your feet. Don't twist your body.

11.5.2.5 Remember, lift with your legs, **NOT YOUR BACK!**

11.5.3 All equipment rooms must be kept clean and equipment must be orderly and properly stored.

11.6 General Maintenance Safety

11.6.1 All electrical tools must be properly grounded.

11.6.2 All electrical plugs, switches, and cords must be in good repair.

11.6.3 Flammable liquids must be properly stored.

11.6.4 Supervisors must instruct employees in safe work practices.

11.6.5 Employees operating machinery are prohibited from wearing neckties, jewelry, and other articles which could become tangled in the machinery.

11.6.6 Written records of all inspections (facilities, equipment, etc.), and any action taken, must be maintained.

11.6.7 Maintenance Shop bottles and containers must be clearly labeled to identify contents.

11.6.8 Only authorized personnel may operate Maintenance Shop power tools, equipment and machinery.

11.7 Biological Hazards - Maintenance Shop employees are responsible for the same biological safety policies found elsewhere in this manual. There are several safety precautions specific to Maintenance Shop personnel:

- 11.7.1 Always make certain laboratory equipment (centrifuge, water bath, safety cabinet, etc.) has been disinfected before servicing, or before transporting to the workshop for servicing or repair. Equipment delivered to the Preventive Maintenance Shop for repair should be tagged as to when the equipment has been disinfected and by whom.
- 11.7.2 Always inform the appropriate Lab Scientist or the SSO whenever an accident occurs involving potentially infectious or toxic materials. **DO NOT** attempt to clean up this type of accident or spill without the help of a knowledgeable supervisor or the SSO.

12.0 REPRODUCTIVE SAFETY

12.1 Introduction

In order to improve awareness and ensure employee reproductive health for women and men, the Laboratories Administration recommends the following precautions. The Laboratory Administration adheres to all State laws relating to “Reasonable Accommodations for Disabilities Due to Pregnancy (Chapters 547 and 548, Article § 20-609).

12.2 Periconceptional Hazards

Exposure of men and women to environmental hazards and drugs during childbearing years has been associated with genetic defects generally not detectable prenatally. Many substances have been shown to produce genetic abnormalities in laboratory preparations and experimental animals, but there is no evidence they produce similar effects in humans. Caution is advised when working in the laboratory. Check MSDSs before working with any potentially hazardous substances.

12.3 Pregnant Employee

- 12.3.1 OSHA Regulations - These regulations establish standards designed to protect all employees. The existing standards presently cover a number of potential hazards.
- 12.3.2 The Registry of Toxic Effects of Chemical Substances (RTECS) identifies many potentially harmful industrial compounds, and provides information on potential carcinogenesis when available.
- 12.3.3 Fetal Effects - Little is known about the factors causing birth defects, mutagenesis, or fetal carcinogenesis, and how they may be related to occupational exposures.
- 12.3.4 Work Assignments – Supervisors may consider re-assignment of pregnant employees on a case by case basis.

- 12.3.4.1 Assessment of Work Exposures - When a pregnant woman is employed, information on her work activity, including biological exposure, chemical exposure, and physical stress, is essential if her physician is to develop a meaningful initial obstetrical database. Assistance in interpreting the information and in determining the potential toxicity of the exposures to which the pregnant employee is subjected, can also be obtained directly from occupational health professionals or from NIOSH and OSHA consultants in regional offices.

12.4 Policy Regarding Pregnant Employees

- 12.4.1 Each employee must report her pregnancy to her supervisor as soon as possible.
- 12.4.2 The goal of safe management in the laboratory is to counteract or minimize risks to the mother or fetus. These actions can enable her to remain on the job, without concern, for as much of the period of pregnancy as possible.
- 12.4.3 Recommendations made to the woman by her physician may be divided into the following categories:
 - 12.4.3.1 The woman may continue to work without change.
 - 12.4.3.2 The woman may continue to work but with certain modifications in environment or activity.
 - 12.4.3.3 The woman should not work.
- 12.4.4 The Laboratories Administration will cooperate with the woman and her physician to enact modifications, where possible, to meet medical recommendations without unreasonably disrupting the normal work environment.
- 12.4.5 The lack of definitive knowledge makes it difficult to provide additional policy statements regarding male or female employees planning to have a child. The Laboratories Administration will review all concerns on a case-by-case basis.
- 12.4.6 Radiation and Pregnancy - For the protection of the unborn child, an occupationally exposed woman should not receive more than 0.5 rem during the 9-month gestation period (NRC Regulatory Guide 8.13). The radiation dose should be limited, especially during the first trimester of pregnancy. During this period, there is a greater possibility of increased sensitivity of the fetus to ionizing radiation.

References

1. 1770 Tenant Guidelines,
http://dhmh.maryland.gov/laboratories/secure/Documents/1770_Tenant_Handbook.pdf
2. Centers of Disease Control and Prevention (CDC), “Biosafety in Microbiological and Biomedical Laboratories,” (BMBL) 5th Edition, 2009.
3. Clinical and Laboratory Standards Institute, “M29-A4, Protection of Laboratory Workers From Occupationally Acquire Infections; Approved Guidelines—Fourth Edition.” May 2014.
4. DHMH Laboratories Administration, Employee Handbook
5. DHMH Laboratories Administration, Respirator Protection Program Policy
6. DHMH Laboratories Administration, Chemical Hygiene Plan
7. DHMH Laboratories Administration, Security Manual (1770 ed.)
8. DHMH Laboratories Administration, Biological Incident Response Plan
9. DHMH Laboratory Administration, Safety Manual 4.0
10. Forest City, “Facility Operating Protocol Manual for DHMH Laboratories Administration.”
11. U.S. Department of Labor, Federal Register, 29 CFR 1910 et seq. (29 CFR 1910.1200 Hazardous Communication, Final Rule February 13, 1996; 29 CFR 1910.1450 Occupational Exposure to Hazardous Chemicals in Laboratories, Final April 3, 2006; and 29 CFR 1910.132 Personal Protective Equipment, Final Rule November 15, 2007.)

Appendix A Employee First Report of Injury Forms

EMPLOYEE FIRST REPORT OF INJURY FORMS AND INSTRUCTIONS

4/1/2017 version

COMPLETING EMPLOYEE FIRST REPORT OF INJURY

1. The employee must notify his/her supervisor that a work related injury has occurred and an Employee First Report of Injury Form will be completed.
2. The employee or an individual acting on the employee's behalf may complete the Employee First Report of Injury Form.
3. The Supervisor or Administrative Officer must complete the Supervisor's Accident Investigation Form, Request for Services: Injury Care Form and ensure Accident Witness Statement Form(s) are completed, if applicable.
 - a. The original completed Employee First Report of Injury must be given to the Personnel – Administration Unit (Jennifer English – 410-767-5532) within 24 hours. The completed First Report of Injury Packet must be given to the Personnel Administration Unit within three (3) working days after the injury occurred. Failure to provide the proper documentation with the established time frame could result in a delay or disapproval of accident leave.
 - b. Copies of the First Report of Injury Packet must be given to the Laboratory Safety Officer (if the Safety Office is out copies are given to Laboratory Quality Assurance Officer) and the Laboratory Personnel Officer before originals are submitted to the Personnel – Administration Unit.
4. Injured employees should be seen on a walk-in basis within three (3) working days of the accident in any of the nine (9) Maryland or five (5) Delaware WorkPro or Occupational Medical Services (OMS) urgent care locations. The employee may carry the Request for Services: Injury Care Form or the Personnel office may fax the form to the medical center.
5. If the employee warrants immediate attention (non-emergency) first call the Personnel Administration Unit. The Request for Services: Injury Care Form must be completed before the employee goes to WorkPro or OMS location.
6. **Timekeeping Workday**. Time Type: sick (timesheet), Time Off Reason: Illness/Injury Documented (self) shall be used for accident level. Time starts when the employee levels to go to their first WorkPro or OMS appointment. Time Type: sick (timesheet), Time Off Reason: Illness/Injury Documented (self) accounts for travel time to and from WorkPro or OMS for any medical appoints related to the injury.

PACKET CONTENTS:

1. Employee's Report of Injury Form
2. Supervisor's Accident Investigation Form
3. Accident Witness Statement Form
4. WorkPro and OMS locations and Map(s)
5. Request for Services: Injury Care Form

Employee's Report of Injury

(To be completed by the employee only.)

Employee's name: _____ Male ___ Female ___
Last First Middle

Date of birth: ___ / ___ / ___ Home telephone # (_____) _____

Home address: _____

City: _____ State: _____ Zip Code: _____

Present classification: _____ How long employed here: _____

Social Security No.: _____ - _____ - _____ Weekly salary: _____

Location of accident: _____
Address Area (loading dock, bathroom, etc.)

Date of accident: _____ Time of accident: _____

Describe fully how accident occurred: (including events that occurred immediately before the accident):

Describe bodily injury sustained (be specific about body part(s) affected):

Recommendation on how to prevent this accident from recurring: _____

Name of supervisor: _____ Phone# _____
Last First

Name(s) of witness (es): _____ Phone# _____
(Attach witness (es) report(s))

When did you report the accident to your supervisor? _____

To whom did you report the injury? _____

Do you require medical attention? Yes: _____ No: _____ Maybe: _____

Name of your treating physician: _____ Phone# _____

Signature of employee: _____ Date: _____

IWIF • 8722 Loch Raven Boulevard, Towson, MD 21286-2235 • www.iwif.com Form may be copied as needed
204A 01/03

Accident Witness Statement

(To be completed by accident witness)

Injured employee's name: _____

Last

First

Middle

Name of witness: _____ Ph. # _____

Last

First

Middle

Job title of witness: _____ How long employed here? _____

Home address of witness: _____

City: _____ State: _____ Zip Code: _____

Location of accident: _____

Address/Name of building

Area (bathroom, etc.)

Date of accident: _____ Time of accident: _____

Describe fully how accident occurred: (including events that occurred immediately before the accident):

Describe bodily injury sustained (be specific about body part(s) affected):

Recommendation on how to prevent this accident from recurring: _____

Name of Witness's Supervisor: _____ Ph. # _____

Last

First

Signature of Witness: _____ Date: _____

204B 01/03

IWIF • 8722 Loch Raven Boulevard, Towson, MD 21286-2235 • www.iwif.com Form may be copied as needed

Supervisor's Accident Investigation

(To be completed by the employee's supervisor or other responsible administrative official)

Location where accident occurred		Employer's Premises: <input type="checkbox"/> Yes <input type="checkbox"/> No		Date of accident or illness
		Job site: <input type="checkbox"/> Yes <input type="checkbox"/> No		
Who was injured?			<input type="checkbox"/> Employee <input type="checkbox"/> Non-Employee	
			Time of accident a.m. or p.m.	
Length of time with firm	Job title or occupation	Name of dept. normally assigned to	How long has employee worked at job where injury or illness occurred? Property/equipment owned by:	
What property/equipment was damaged?				
What was employee doing when injury/illness occurred? What machine or tool was being used? What type of operation?				
How did injury/illness occur? List all objects and substances involved.				
Part of body affected/injured?		Any prior physical conditions? If so, what? <input type="checkbox"/> Yes <input type="checkbox"/> No		
Nature and extent of injury/illness and property damaged (be specific)				

PLEASE INDICATE ALL OF THE FOLLOWING WHICH CONTRIBUTED TO THE INJURY OR ILLNESS

- | | | |
|--|--|--|
| <input type="checkbox"/> Failure to lockout | <input type="checkbox"/> Failure to secure | <input type="checkbox"/> Horseplay |
| <input type="checkbox"/> Improper dress | <input type="checkbox"/> Improper guarding | <input type="checkbox"/> Improper instruction |
| <input type="checkbox"/> Improper maintenance | <input type="checkbox"/> Improper protective equipment | <input type="checkbox"/> Inoperative safety device |
| <input type="checkbox"/> Lack of training or skill | <input type="checkbox"/> Operating without authority | <input type="checkbox"/> Physical or mental impairment |
| <input type="checkbox"/> Poor housekeeping | <input type="checkbox"/> Poor ventilation | <input type="checkbox"/> Unsafe arrangement or process |
| <input type="checkbox"/> Unsafe equipment | <input type="checkbox"/> Unsafe position | <input type="checkbox"/> Other _____ |

Supervisor's corrective action to ensure this type of accident does not recur: _____

Was employee trained in the appropriate use of Personal Protective Equipment/Proper safety procedures? _____ Yes _ No _

Was employee cautioned for failure to use Personal Protective Equipment/Proper safety procedures? _____ Yes _ No _

Did employee promptly report the injury/illness? _____ Yes _ No _

Is there modified duty available? _____ Yes _ No _

Supervisor's name

Supervisor's signature

Phone#

Date






204C 01/03

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Form may be copied as needed

State of Maryland - WORKPRO & OMS





WORKPRO DE Sites

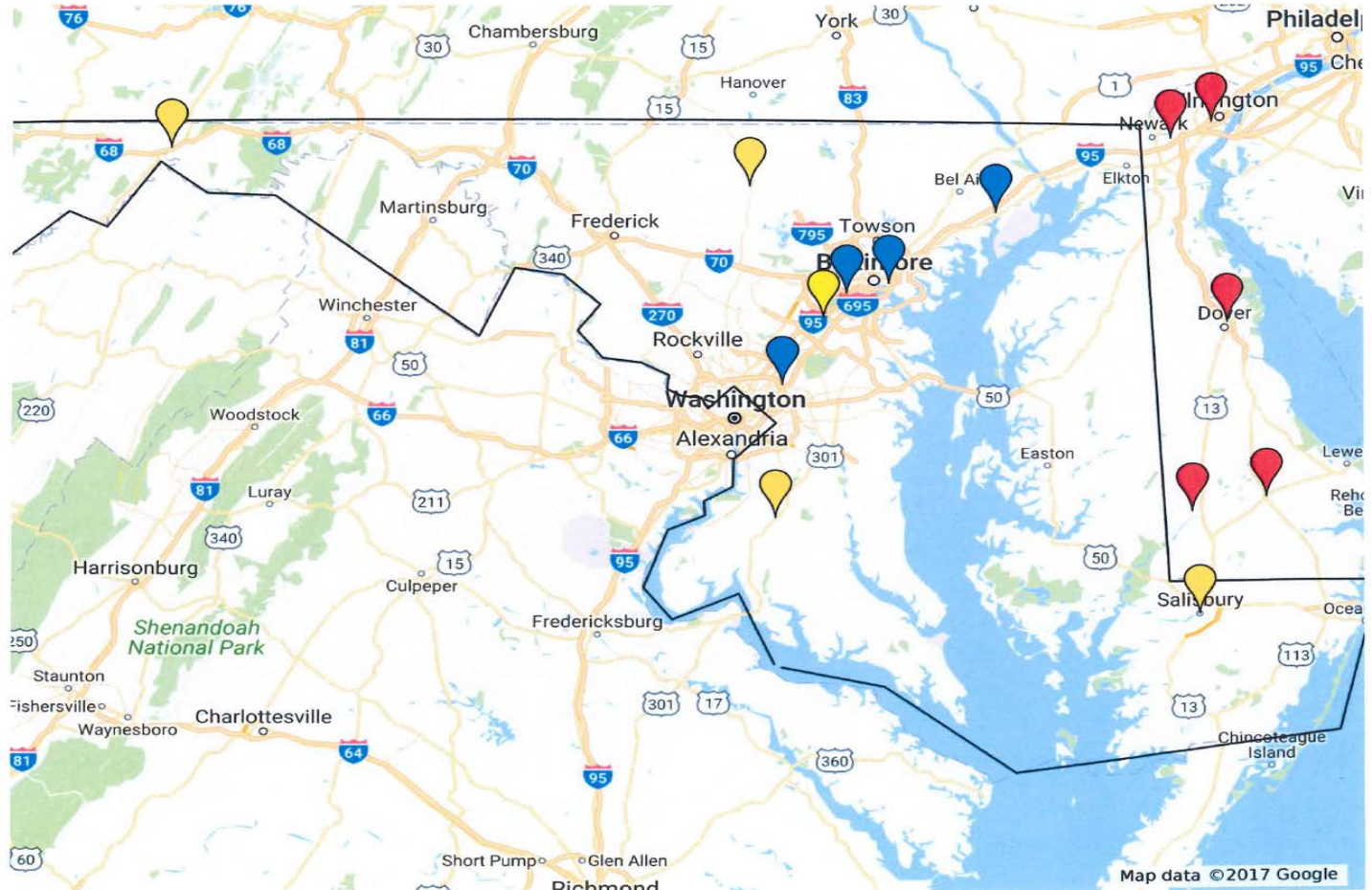
-  WORKPRO, Wilmington DE
-  WORKPRO, Newark DE
-  WORKPRO, Dover DE
-  WORKPRO, Georgetown DE
-  WORKPRO Seaford DE

WORKPRO Maryland

-  WORKPRO/Pivot, Westminster
-  WORKPRO Salisbury
-  6785 Business Pkwy - Elkridge
-  WORKPRO Cumberland
-  WORKPRO, Waldorf

Occupational Medical Services

-  OMS, B'More (Arbutus)
-  OMS, B'More (Canton)
-  OMS, Belcamp
-  OMS, Greenbelt



**WORKPRO Occupational Health Locations
&
Occupational Medical Services (OMS) Locations
Effective 4/1/17**

Note: Contact Names, Numbers, Emails to follow.

WORKPRO Maryland

6785 Business Parkway, Suites 1&2
Elkridge, MD 21075
Hours: Mon – Fri 7:30am – 4:30pm

844 Washington Road, Unit 203
Westminster, MD 21157
Hours: Mon – Fri 7:30am – 4:30pm

2618 North Salisbury Blvd, Suite 130
Salisbury, MD 21801
Hours: Mon – Fri 7:30am – 4:30pm

Opening Date: 4/1/17

2875 Crain Highway
Route 301 South
Waldorf, MD 20601
Hours: Mon – Fri 7:30am – 4:30pm

14302 Barton Boulevard SW
Cumberland, MD 21502
Hours: Mon – Fri 7:30am – 4:30pm

WORKPRO Delaware

914 Justison Street
Shipyard Shops
Wilmington, DE 19801
Hours: Mon - Fri 7:30am – 5:00pm

4051 Ogletown-Stanton Road, Suite 102
Iron Hill Corporate Center, Sabre Wing
Newark, DE 19713
Hours: Mon - Fri 7:30am – 5:00pm

283 North DuPont Highway
Kohl's Center
Dover, DE 19901
Hours: Mon – Fri 7:30am – 4:30pm

543 North Shipley Street
Professional Building, Suite F
Seaford, DE 19973
Hours: Mon - Fri 7:30am – 4:30pm

503 W. Market Street, Suite 100
Nanticoke Immediate Care
Georgetown, DE 19947
Hours: Mon - Fri 7:30am – 4:30pm

OMS Locations

Arbutus

4807 Benson Avenue
Baltimore, MD 21227
Hours: Open 24 Hrs

Belcamp

1200 Brass Mill Road, Suite C
Belcamp, MD 21017
Hours: Mon – Fri 7:00am – 5:00pm

Canton

3600 O'Donnell Street, Suite 170
Baltimore, MD 21224
Hours: Mon – Fri 7:30am – 5:00pm

Greenbelt:

7933 Belle Point Drive,
Greenbelt, MD 20770
Hours: Mon – Fri 8:00am – 4:30pm



WORKPRO
OCCUPATIONAL HEALTH



**OCCUPATIONAL
MEDICAL SERVICES**
Your Partner in Employee Health

State of Maryland
Authorization for Examination or Treatment
(Patient Must Present Photo ID at Time of Service)

Agency: _____ Today's Date: _____
(List Agency or Sub-Agency to Receive Invoice) Appointment Date/Time (if any): _____

Location: _____ Authorized By: _____

Agency Phone No.: _____ Agency Fax No: _____

Employee: _____ Employee Date of Birth: _____

Please check all that apply:

☒ **Work Injury/Illness** Date of Injury _____ Claim# (if available) _____

Physical Examination

☐ Pre-placement ☐ Pre-placement w Ergonomic Assessment ☐ DOT - Regulated

☐ Fitness for Duty/Ability to Work ☐ Medical Surveillance ☐ FAA - MDOT

☐ Other: _____

Substance Abuse Testing

☐ DOT - Regulated Drug Test ☐ MDOT Non-regulated Drug Test

☐ DOT - Regulated Alcohol (Breath) ☐ MDOT Non-regulated Alcohol Test (Saliva)

☐ Other: _____

Reason for Substance Abuse Testing

☐ Pre-employment ☐ Reasonable Suspicion ☐ Post-accident ☐ Random

☐ Follow-up ☐ Return to Duty

Psychological Services (scheduled through WORKPRO Elkridge MD location)

☐ Psychological Testing ☐ SAP ☐ Critical Incident Management

Other Services

☐ Respirator Fit Test ☐ Audiogram ☐ PPD ☐ Pulmonary Function Test ☐ EKG

☐ Chest X-ray ☐ Vaccination: _____ ☐ Other: _____

Special instructions/comments _____

For WORKPRO locations and individual office hours visit www.workprohealth.com

Appendix B Chemical Classifications, Classes, Flash points, Boiling points, Glove Compatibility Resources, and Specific Chemical Incompatibilities

Table 1 - Liquid Chemical Classifications

	Flammable				Combustible
	Class IA	Class IB	Class IC	Class II	Class III
Flash Pt. in EF	73	73	73	100	140
Boiling Pt. in EF	100	100	100	140	200

Table 2 - Maximum Allowable Container Size

	Class IA	Class IB	Class IC	Class II	Class III
Glass or Plastic	1 pt.	1 gal.	1 gal.	1 gal.	1 gal.
Safety Cans	2 gal.	5 gal.	5 gal.	5 gal.	5 gal.
Metal Shipping Cans	1 gal.	5 gal.	5 gal.	5 gal.	5 gal.

Table 3 - General Classes of Incompatible Chemicals

Acids (Oxidizing Agents)

Chlorates
 Chromates
 Chromium trioxide
 Dichromates
 Halogens
 Halogenating agents
 Nitric acid
 Nitrates
 Perchlorates
 Peroxides
 Permanganates
 Persulfates

Bases, Metals (Reducing Agents)

Ammonia, (anhydrous and aqueous)
 Carbon
 Metals
 Metal hydrides
 Nitrites
 Organic compounds
 Phosphorus
 Silicon
 Sulfur

Table 4 - Solvent Flash Points, Boiling Points, and Classification

Solvent	Flash Pt. EF	Boiling Pt. EF	Classification
Acetone	0	134	IB
Acetonitrile	42	179	IB
Acetyl acetone	105	284	II
Acetyl chloride	40	124	IB
Acrylonitrile	32	171	IB
Amyl acetate	77	300	IC
N-amyl alcohol	91	280	IC
Aniline	158	364	III
Benzene	12	176	IB
N-butyl acetate	72	260	IB
N-butyl alcohol	84	243	IC
Carbon disulfide	-22	115	IB
Cyclohexane	-4	179	IB
Cyclopentane	20	121	IB
Diesel fuel	100-300	—	II
Diethylamine	0	134	IB
N-N-dimethyl formamide	136	307	II
1,1-Dimethyl hydrazine	5	214	IB
Dioxane	25	214	IB
Ethanol	24	171	IB
Ethanol (denatured)	56-61	173	IB
Ethyl acetate	24	171	IB
Ethyl amine	0	62	IA
Ethyl butyrate	78	248	IC
Ethylenediamine (anhydrous)	110	241	II
Ethyl ether	-49	95	IA
Ethylene glycol	232	387	IIIB
Heptane	25	209	IB
Hexane	-7	156	IB

Table 4 - Solvent Flash Points, Boiling Points, and Classification (cont.)

Solvent	Flash Pt. EF	Boiling Pt. EF	Classification
Isobutyl alcohol	82	225	IC
Iso-octane	70	257	IB
Isopropyl alcohol	53	181	IB
Methyl alcohol	52	147	IB
Methyl ethyl ketone	21	176	IB
Methyl isobutyl ketone	73	244	IC
Mineral oil	380	680	IIIB
Mineral spirits	140	300	II
Nitromethane	95	215	IC
N-octane	70	250	IB
N-pentane	40	97	IA
Petroleum ether	0	95-140	IA - IB
Propyl alcohol	77	207	II
Pyridine	68	239	IB
Toluene	40	239	IB
2,2,4-trimethylpentane	10	211	IB
Turpentine	95	300	IB
Xylene	81-91	281-292	IB

Glove Compatibility Charts and Resources

Chemical Resistance of Glove Material

Protective gloves are not equally effective for every hazardous chemical. Some chemicals will "break through" the glove material in a very short time. Therefore, glove selection is based on the specific chemical utilized. The performance of gloves depends on their thickness and conditions of manufacture, as well as their material of construction. It is best to consult the manufacturers' glove selection guides. Here are select links to four (4) glove manufacturers found at the Laboratories Administration:

- 1) Ansell Gloves Compatibility Chart
http://www.ansellpro.com/download/Ansell_7thEditionChemicalResistanceGuide.pdf
- 2) MicroFlex Gloves Compatibility Chart
http://www.microflex.com/Products/~media/Files/Literature/Domestic%20Reference%20Materials/DOM_Reference_Chemical%20Resistance.ashx
- 3) Chemrest Chemical Guide
<http://www.showabestglove.com/site/chemrest/default.aspx>
- 4) Kimberly Clark Gloves Compatibility Chart
http://www.kcprofessional.com/us/download/Technical%20Data%20Sheets/K2365_09_01_SN_Chem_Guide_v11.pdf

Government and Other Manufacturer Glove Compatibility Selections Guides and/or Permeability Data

- 1) **National Institute for Occupational Safety and Health (NIOSH). Guide for Evaluating the Performance of Chemical Protective Clothing 90-109**, link <http://www.cdc.gov/niosh/docs/90-109/>
- 2) **Ansell-Edmont** - Ansell Industrial, 1300 Walnut St., Coshocton, OH 43812. From the AnsellPro.com home page, link to the **Chemical Resistance Guide: Permeation and Degradation Data**, http://www.ansellpro.com/download/Ansell_7thEditionChemicalResistanceGuide.pdf. Ansell's interactive chemical resistance and glove recommendations guide to nearly 200 industrial chemicals and mixtures. Links to toxicology information, for thousands of chemicals from the National Library of Medicine database, is also provided.
- 3) **Best Manufacturing Company** - 579 Edison Street, Menlo, GA 30731. **Comprehensive Guide to Chemical-Resistant Best® Gloves** - Software package with a 200-plus chemical database is free for downloading. It will help you determine which of the 21 chemical-resistant glove materials, in varying thicknesses, to use for specific applications. These range from where contact with the chemical is brief or intermittent, to worst-possible-case situations, such as total immersion (a decidedly imprudent procedure). Supports Windows 3.1, 3.11, 95, or NT.
<http://www.bestglove.com/products/chemresist/chemresist.htm> This information is also available on the website, where you can search by chemical name, CAS number, and chemical class.
- 4) **Lab Safety Supply** - PO Box 1368, Janesville, WI 53547. **Chemical Protective Gloves, EZ Facts Document 191** - Provides general information about OSHA regulations, selection factors and criteria, and types of glove materials. For specific information you can e-mail technical support, techsvc@labsafety.com, or consult the chemical compatibility chart contained in their hard copy catalog. Find and html version of the fact sheet at: <http://www.labsafety.com/refinfo/ezfacts/ezf191.htm>.
- 5) **MAPA Professional** - 85 85 Innsbruck Drive, Buffalo, NY 14227. **Permeation, Degradation and Breakthrough Rates** - for 111 chemicals against 5 polymeric materials, including their Stansolv® Nitrile and Stanzoil® Neoprene gloves.
<http://www.mapaglove.com/ChemicalSearch.cfm?id=0>

Table 6 - Specific Chemical Incompatibilities

A	B
Acetylene and monosubstituted acetylene (RC/CH)	Group IB and IIB metals and their salts Halogens Halogenating chemicals
Ammonia, anhydrous and aqueous	Halogens Halogenating chemicals Mercury Silver
Alkali and alkaline earth carbides hydrides hydroxides metals oxides peroxides	Water Acids Halogenated organic compounds Oxidizing agents
Azides, inorganic	Acids Heavy metals and their salts Oxidizing agents
Cyanides, inorganic	Acids Strong bases
Mercury and its amalgams	Acetylene Ammonia, anhydrous and aqueous Nitric acid Sodium azide
Nitrates, inorganic	Acids Reducing agents
Nitric acid	Bases Chromic acid Chromates Metals Permanganates Reducing agents Sulfides Sulfuric acid
Nitrites, inorganic	Acids Oxidizing agents
Organic compounds Organic acetyl halides Organic anhydrides Organic halogen compounds	Oxidizing agents Bases Organic hydroxy and amino compounds Bases Organic hydroxy and amino compounds Group IA and IIA metals Aluminum

Table 6 - Specific Chemical Incompatibilities (cont.)

A	B
Organic compounds (cont.)	
Organic nitro compounds	Acids Oxidizing agents
Oxalic acid	Mercury and its salts Silver and its salts
Phosphorus	Oxidizing agents Oxygen Strong base
Phosphorus pentoxide	Alcohols Strong bases Water
Sulfides, inorganic	Acids
Sulfuric acid (concentrated)	Bases Potassium permanganate Water




EMERGENCY EYEWASH STATION WEEKLY OPERATIONAL CHECK

[illegible]

EMERGENCY EYEWASH EQUIPMENT INSTRUCTIONS

ANSI Z358.1 Standard

It is important to recognize that emergency eyewash stations are not a substitute for proper PERSONAL PROTECTIVE EQUIPMENT (PPE). Lab occupants must always wear eye, face and hand protection with protective clothing that is appropriate for the hazard.

-  Activate the eyewash station WEEKLY to verify proper operation and to flush the system. This operational check is to be recorded on a tag attached to the unit or in a log kept in close proximity to the unit.
-  Keep basin **clean** and free of debris.
-  Inspect the eyewash station ANNUALLY for compliance with the ANSI Z358.1 standard.

Annual Eyewash Inspection Checklist

- ☐ There is a controlled, low velocity flow of water that rinses both eyes without causing injury.
- ☐ Spray heads are protected from airborne contaminants.
- ☐ Spray head protection is removed without a separate motion when activated.
- ☐ Valve actuator is easy to locate, simple to use, opens in 1 second or less, and stays open until intentionally shut off.
- ☐ Unit delivers at least 0.4 gallons per minute (1.5 liters) for 15 minutes.
- ☐ Water temperature is tepid (lukewarm).
- ☐ All units are activated weekly to check for proper operation and to flush the system.
- ☐ All employees are instructed in the location and proper use of the eyewash.

To Flush Eyes

Hold eyelids open and roll the eyeballs so water will flow on all surfaces of the eye and under the eyelid. Flush for at least 15 minutes. Get medical attention.

Appendix D Radiation Dose, Units, Decay Tables

Table 1 - Radiation Dose Limits and Recommendations

Person Exposed	Maximum Permissible Dose ^a
<u>Occupationally exposed (restricted areas)^b</u>	
Whole body, head and trunk, active blood-forming organs, gonads, lenses of eyes	5 rem/year, 1.25 rem/quarter
Skin of whole body	30 rem/year, 7.5 rem/quarter
Hands and forearms, feet and ankles	75 rem/year, 18.75 rem/quarter
Thyroid	30 rem/year, 7.5 rem/quarter
Other organs not listed above	15 rem/year, 3.75 rem/quarter
<u>General public (unrestricted area)^{b,c}</u>	0.5 rem/year
<u>Special exposure conditions^d</u>	
Occupationally exposed pregnant woman ^e	0.5 rem during gestation period
Students ^f	0.1 rem/year

^a Dose of 3 rem/quarter maximum allowed (12 rem/year) only if a cumulative lifetime exposure history is maintained and the individual dose does not exceed 5(N-8) rem, where N=age in years.

^b 10 CFR 20

^c One-tenth the occupational maximum permissible dose.

^d NCRP Report no. 39. Basic Radiation Protection Criteria (NCRP Publications, Washington D.C. 1971).

^e Recommended dose guide to protect the fetus.

^f From course-related exposure. Recommended guide, not in addition to the 0.5 rem/year public maximum permissible dose.

Table 2 - Relationship of Units

Radiological Quantity	Old Unit	SI Unit	Relationship between units			
Activity of a Radioactive Material	The curie 1 Ci=3.7x10 ¹⁰	The becquerel	Bq	=2.7x10 ⁻¹¹ Ci	1 ΦCi	=37 kBq
		1 Bq =1 dis/s	1 kBq	=2.7x10 ⁻⁸ Ci	1mCi	=37 MBq
		10 ³ Bq =1 kilobecquerel (kBq)	1 MBq	=2.7x10 ⁻⁵ Ci	1Ci	=37 GBq
		10 ⁶ Bq =1 megabecquerel (MBq)		27 ΦCi		
		10 ⁹ Bq =1 gigabecquerel (GBq)	1 GBq	= 27 mCi	10 ³ Ci	=37 TBq
		10 ¹² Bq =1 terabecquerel (TBq)	1 TBq	= 27 Ci	10 ⁶ Ci	=37 PBq
		10 ¹⁵ Bq =1 petabecquerel (PBq)	1 PBq	=27 kCi	10 ⁹ Ci	=37 Ebq
		10 ¹⁸ Bq =1 exabecquerel (EBq)	1 Ebq	=27 Mci		
Exposure	The roentgen 1 R=the production of ions (of one sign) carrying a charge of 2.58 x 10 ⁻⁴ C/kg of air.	No special named unit for exposure. The unit for ionization is C/kg, and this can be used to express the results of ionization chamber measurements as an intermediate step in the determination of absorbed dose.	—			
Absorbed Dose	The rad 1 rad =1.01J/kg	The gray 1 Gy =1 J/kg 1 Gy =10 ³ mGy=10 ⁶ ΦGy	1 ΦGy	=0.1 mrad	1 mrad	=10 ΦGy
			1 mGy	=100 mrad	1 rad	=10 mGy
			1 Gy	=100 rad	100 rad	=1 Gy
Dose Equivalent	The rem 1 rem=1 rad x <i>Q</i> <i>Q</i> is the quality factor	The sievert 1 Sv =1Gy x <i>Q</i> x <i>N</i> 1 Sv =10 ³ mSv=10 ⁶ ΦSv <i>N</i> is the product of all other modifying factors (currently taken as 1 by ICRP).	1 ΦSv	=0.1 mrem	1 mrem	=10 ΦSv
			1 mSv	=100 mrem	1 rem	=10 mSv
			1 Sv	=100 rem	100 rem	=1 Sv

Table 3 – Half Lives and Decay Schemes of Some Commonly Used Radioisotopes

Radioactive Group Water, 168 h Isotope environmental	Half -life		Radiation emitted		Specific gamma constant (Γ) ^{a,b}	Maximum permissible body burden ^c (μCi)	MPC ^d (μCi/ml)			
	Physical ^a	Biological ^c	Type	Energy ^e (MeV)			Air, 40 h,	Air, 168 h	Water, 40 h	
							occupational	environmental	occupational	
Low radio-toxicity										
³ H	12.3 yr	12 days	∃&	0.0186 (max)		1.000	5x10 ⁻⁶	2x10 ⁻⁷	1x10 ⁻¹	3x10 ⁻³
¹⁴ C	5.720 yr	10 days	∃&	0.156 (max)		300	4x10 ⁻⁶	1x10 ⁻⁷	2x10 ⁻²	8x10 ⁻⁴
Immediate Radiotoxicity										
³² P	14.3 days	19 days	∃&	1.71 (max)		6 (bone)	7x10 ⁻⁸	2x10 ⁻⁹	5x10 ⁻⁴	2x10 ⁻⁵
³⁵ S	87.4 days	90 days	∃&	0.167 (max)		400	3x10 ⁻⁸	9x10 ⁻⁹	2x10 ⁻³	6x10 ⁻⁵
⁵¹ Cr	27.7 days	616 days	(x&	0.320 (9.8%) 0.005 (22%)	0.16	800	1x10 ⁻⁵	4x10 ⁻⁷	5x10 ⁻²	2x10 ⁻³
High radio-toxicity										
¹³¹ I	8.04 days	138 days	∃& (0.606 (22%) 0.364 (81.2%) 0.637 (7.3%) 0.284 (6.1%) 0.035 (6.5%)		0.7 (whole body) 0.14 (thyroid) 0.65 (thyroid)	9x10 ⁻⁹	1x10 ⁻¹⁰	6x10 ⁻⁵	3x10 ⁻⁷
¹²⁵ I	60 days	138 days	(0.027 (113%) 0.031 (25%) 0.257 (max)	2.2 0.7		5x10 ⁻⁹	8x10 ⁻¹¹	4x10 ⁻⁵	2x10 ⁻⁷
⁴⁵ Ca	163 days	1.8x10 ⁴ days	K _{ax} K _{ax} ∃&			30	3x10 ⁻⁸	1x10 ⁻⁹	3x10 ⁻⁴	9x10 ⁻⁶

^aRadiological Health Handbook, Bureau of Radiological Health, U.S. Dept. of H.E.W., 1970, USGPD, Washington D.C.; An Introduction to Radiation Protection, 2nd. ed. 1979, Martin, A. and Harbison, S.A.

^bThe specific gamma constant, Γ , is in units of roentgens per hour per millicurie at 1 cm or $\Gamma/10$ = roentgens per curie at 1 m.

^cICRP Committee II Report on Permissible Doses for Internal Radiation, 1960, Health Physics Journal 3:1-380.^d10 CFR ^eParentheses indicate percent of time that a disintegration results in this type of radiation emission. max, Maximum energy of the beta particle emitted by the radioisotope. K_a, X-ray emission corresponding in energy to the K_a electron orbit of the radioisotope.

