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Electrophoresis Safety		
Investigator: General Safety	Location: EHS	Revision: 00

1.0 PURPOSE:

Electrophoresis, a technique which separates molecules based on their electrical charge, is frequently used in today's laboratories. The increasing popularity of electrophoresis brings up issues of electrical safety and gel disposal. In any type of electrophoresis - disc, gel, isoenzyme or lipoprotein - there is movement of particles in an electric field toward one or the other electric pole, cathode or anode.

Electrophoresis equipment can be a major source of electrical hazard in the laboratory. The presence of high voltage and conductive fluid in this apparatus presents a potentially lethal combination. Many people are unaware of the hazards associated with this apparatus; even a standard electrophoresis operating at 100 volts can deliver a lethal shock at 25 milliamps. In addition, even a slight leak in the device tank can result in a serious shock.

2.0 SCOPE:

This procedure applies to all Louisiana State University Personnel that use and handle electrophoresis equipment. It is the intent of this guideline to provide information on the safe use of electrophoresis equipment and afford employee protection from the associated health and physical hazards.

3.0 RESPONSIBILITIES:

Only trained and qualified personnel shall be allowed to operate electrophoresis equipment. Supervisors are responsible for ensuring that personnel are trained to use electrophoresis equipment in a safe manner.

4.0 DEFINITIONS:

4.1 Electrophoresis – A Chemical separation technique which separates molecules based on their size and electrical charge.

5.0 REFERENCES:

Partially extracted from University of Vermont 'Safety Notes'. Winter 1993

6.0 MATERIALS and/or EQUIPMENT:

Personal Protective Equipment

7.0 PROCEDURES:

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Precautions for safely operating electrophoresis apparatus to prevent electrical shock during use are described below.

7.1 General Precautions

- 7.1.1 When locating, or working around or near an electrophoresis unit, avoid unintentional grounding points and conductors (e.g., sinks and other water sources, metal plates, aluminum foil, jewelry, pipes, or other metal equipment). If a darkened box is needed for light sensitive work, a black photographer's cloth will work as long as it does not come in contact with the buffer. Non-conducting benches (wood or plastic) and floors (and/or rubber mats) are recommended.
- 7.1.2 Always think and look before touching any part of the apparatus. A thin film of moisture can act as a good conductor of electricity.
- 7.1.3 Some power supplies produce high voltage surges when they are first turned on, even if the voltage is set to zero. Do not ignore safety rules just because the voltage is low. Changes in load, equipment failure, or power surges could raise the voltage at anytime.
- 7.1.4 Do not touch any cooling apparatus connected to a gel. The current can be conducted through the tubing.
- 7.1.5 Do not run electrophoresis equipment while unattended.
- 7.1.6 If electrophoresis buffer is spilled or leaks from the gel box, stop the run and clean up the bench top immediately.
- 7.1.7 Post "Danger—High Voltage" warning signs on the power supply and buffer tanks.

7.2 Selecting a Good Location for the Equipment

- 7.2.1 Locate the equipment where it will not be easy to knock over or trip on.
- 7.2.2 Place the electrophoresis unit and its power supply so that the on/off switch is easy to reach and the power-indicator light is easily seen.
- 7.2.3 Always maintain adequate clearance around the apparatus. Do not permit leads to dangle below the lab bench. At the lab bench, position the power supply so that it is not necessary to reach across the apparatus to make connections to turn the power on or off. Whenever possible, set the power supply on a shelf above the gel box. Good housekeeping is essential.

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7.3 Pre-Operation

- 7.3.1 Test the power supply to ensure that all switches, lights, and the floating output circuit is functioning properly. Record the inspection date and test for open circuit and GFCI protection, if the power supply has this feature.
- 7.3.2 Inspect insulation on the high voltage leads for signs of deterioration (e.g., exposed wires, cracks or breaks, etc.) and ensure that these items are not hanging over the bench top.
- 7.3.3 Check all safety interlock features, including alarms, for proper functioning. Don't override safety devices.
- 7.3.4 Inspect the buffer tanks for cracks or leaks, exposed connectors, or missing covers, and correct deficiencies prior to use.
- 7.3.5 Connect both supply leads at the same time (to prevent one lead from being live in your hand) to the power supply before turning on the power supply, or connect one lead at a time using one hand only.
- 7.3.6 Ensure that your gloved hands are dry while connecting the leads or touching any electrical apparatus.

7.4 Post-Operation

- 7.4.1 Turn off the power supply before opening the lid. Do not rely on safety interlocks, as they can fail.
- 7.4.2 The user should always turn off the main power supply switch and wait 15 seconds (the voltage may not be completely discharged from internal capacitors) before making any disconnection or connections. After use, turn the power supply off before disconnecting both leads from the power supply.

7.5 Personal Protective Equipment and Training

- 7.5.1 Principal Investigators or Lab Managers are responsible for providing instruction and demonstrating safe use of electrophoresis units to laboratory workers. Instruction should cover operating procedures written by the manufacturer and/or laboratory, as well as the associated hazards, the correct personal protective equipment (lab coats, gloves, and eye protection), and applicable emergency procedures.

8.0 HAZARDS OF ELECTROPHORESIS GELS

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A discussion of electrophoresis would not be complete without mentioning the gels and the chemical hazards they can carry. Many researchers believe the gels are harmless and, while agar itself may be, the additives used are often hazardous. For example, various catalysts, denaturants, stains and solubilizing agents contain a variety of chemicals, including formamide, phenol, and acrylamide. This can result in unforeseen results. For example, a Canadian university analyzed agarose gels and found heavy metals, even though no metals or metal-containing reagents were used in the gel preparation. Presumably, the metals leached from the electrical contacts while the electrophoresis happened.

Ethidium bromide, commonly used to visualize nucleic acid, is a mutagen and should be handled with caution, even when mixed in the gel. Ethidium bromide is a potent mutagen and moderately toxic after an acute exposure. Ethidium bromide can be absorbed through skin, so it is important to avoid any direct contact with the chemical. Ethidium bromide is also an irritant to the skin, eyes, mouth, and upper respiratory tract. It should be stored away from strong oxidizing agents in a cool, dry place, and the container must be kept undamaged and tightly closed. Unwanted solid Ethidium bromide, gels, and all working solutions must be disposed of through OES. Gels should be allowed to dry by evaporation prior to disposal in order to reduce the cost (charge is by weight). Disposal of Ethidium bromide into the sanitary sewer (sink drains) is prohibited. Working solutions can be disposed of through OES or may be rendered non-toxic as the last step of your experimental process.

Acrylamide also poses significant hazards. It is a potent nerve toxin in its unpolymerized state, although it is less toxic when polymerized. In making gels, however, the polymerization process is never fully complete, and small amounts of acrylamide monomer are always present

- 8.1 Researchers should handle gels with caution, wearing gloves and washing their hands often
- 8.2 These materials should be disposed of as hazardous waste. Collect your gels in a leak proof container and attach a hazardous waste tag to it when it is full. OES will help you send this waste to its proper disposal site.

9.0 CONTINGENCIES:

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- 9.1** In case of a fire, explosion, or gas leak evacuate individuals from the area and call the emergency response (911). Notify supervision and adjacent personnel as quickly as possible. Observe appropriate procedures for personal injury or fire as provided in OES Web site.
- 9.2** In case of a chemical spill, alert others in the immediate vicinity and notify your supervisor. Determine the severity of the spill and proceed as appropriate. Small spills may be cleaned up by laboratory personnel. For large spills, notify OES (578-5640) and Campus Police (911 or 578-3231). If possible to do so safely (without risk of over-exposure), take action to stop the release. Ensure that extraneous personnel remain at a safe distance until the spill is completely cleaned-up

10.0 REVIEWS AND REVISIONS:

This procedure shall be reviewed for compliance and effectiveness and revised as necessary on an annual basis.

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