manufacturer for replacement gaskets.

- Inspect the electrophoresis chamber for buffer leaks, caused by crazing or cracks in the plastic. Loss of buffer can lead to electrical arcing and fires.
- Inspect the safety guards to ensure proper function, including no load sensors, open load sensors, and ground leakage detectors on the power supply and safety interlocks on the cover.

Preventing Injuries

- Read and follow the manufacturer's instructions.
- Develop and implement written Standard Operating Procedures (SOPs) and train employees and students.
- Do not alter or modify the equipment without written approval from the manufacturer.
- Repairs and maintenance should only be done by a qualified technician.
- Do not defeat or remove safety interlocks.
- Keep the area free of organics, solvents, and combustibles.
- Only use electrophoresis chambers with covers, preferably ones that are interlocked with the power supply.
- Be sure that banana plugs are fully seated. Arcing may occur if the plugs are not completely inserted.
- Make sure power supplies and apparatus are properly matched. Some chambers may be damaged by high voltages.
- Always shut off the power prior to disconnecting leads, accessing the chamber, or adjusting the settings.
- Handle power leads one lead at a time with only one hand to reduce the likelihood of electrical shock.
- You are strongly encouraged to only use newer power supplies with no load sensors and chambers that are equipped with safety interlocks.

Getting Assistance

Questions relating to safe operation of electrophoresis power supplies and chambers should be directed to the manufacturer.

EH&S can provide additional training regarding a wide range of laboratory practices, including the safe operation of electrophoresis units.

WASHINGTON STATE UNIVERSITY

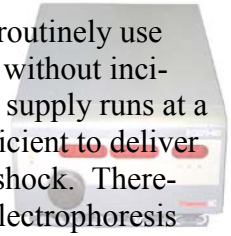
Environmental Health & Safety
P.O. Box 641172
Pullman, WA 99164-1172
(509) 335-3041

Wenatchee....509-663-8181
TriCities.....509-372-7163
Vancouver.....360-546-9706
Spokane.....509-358-7500

http://www.ehs.wsu.edu

Environmental Health & Safety

Electrophoresis Power Supply Safety



Many laboratories routinely use electrophoresis equipment without incident. However, the power supply runs at a voltage and amperage sufficient to deliver a potentially fatal electric shock. Therefore, it is essential to use electrophoresis power supplies safely.

Electrical Hazards

The electric shock from an electrophoresis power supply can cause burns and damage to skin, muscles and nerves. In general, the greater the amperage, the greater the hazard. Amperages greater than 50 milliamps (mA) can be fatal. Typical electrophoresis power supplies produce direct current (DC) up to 3,000 volts and 500 mA.

Voltage and Amperage

Most electrophoresis power supplies carry clearly visible labels warning "Danger, High Voltage". Granted, although a shock of a few thousand volts is uncomfortable, it's not going to harm most people. The current, or amperage, is what poses the danger. While the volts cause the shock, the amps cause the physical damage to the body. The high current or amperage found in most electrophoresis power supplies is sufficient to cause harm.

The common saying among electricians is "current kills". Even a relatively low voltage shock can be fatal, if the amperage is high enough. So why worry about voltage? To understand that, we need to review Ohm's law which correlates current (I), voltage (E) and resistance (R):

$$I = E / R$$

Current (I) is directly proportional to the voltage (E) (i.e., the power supply) and inversely proportional to the resistance (R) of the circuit (i.e., whatever the power passes though).

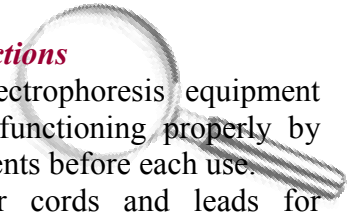
If your wet hands touch exposed live power leads, your body would have a resistance between 1000 to 10,000 W. At 120 V (DC), the current passing through you would be between 12 and 120 mA. As the table below shows, a 12 mA current delivers a shock, however a 120 mA current is sufficient to cause respiratory paralysis. Given that most power supplies deliver up 3,000 V (DC), the risk of physical harm is very real.

Effect	mAmp DC	mAmp AC
Shock, not painful	6	1.2
Painful shock	41	6
Shock, muscular contraction	51	10.5
Severe shock, breathing difficulties	60	15
Ventricular fibrillation	500	100

Physical Effects of Electric Shock

An electrical shock can overstimulate nerves causing wide ranging physiological effects.

- Your **heart** may stop or flutter. Your arteries also may contract, making it harder for your heart to pump blood.
- Electricity through the **muscles** causes them to contract, or spasm. This might make it so you can't let go of the energized equipment. Contractions of the chest muscles may make it difficult to breathe.
- Electricity can damage **nerves,** causing unconsciousness, paralysis, brain damage, and other problems.
- Electricity can **burn** skin where it enters and exits. These burns may be sufficient to kill a person or destroy an arm or a leg.



Equipment Inspections

Inspect electrophoresis equipment and ensure it is functioning properly by checking components before each use.

- Inspect power cords and leads for frayed, cracked or dried out cords; exposed copper wire at the banana jacks (caused by pulling on the wire instead of the jack when trying to remove the jack); and corroded or loose fitting banana plugs, banana jacks, or electrode connection nut, which may cause electrical arcing between the plugs, resulting in fire or irreproducible results.
- Discard and replace all cords that do not pass the inspection. Some manufacturers recommend replacing banana jacks annually.
- Inspect gaskets on vertical electrophoresis chambers to ensure they are not leaking. If leaks are found, contact the