V. ELECTRICAL SAFETY

1.0 General Electrical Safety

1.1 The danger of injury through electrical shock is possible whenever electrical power is present. When a person's body completes a circuit and thus connects a power source with the ground, an electrical burn or injury is imminent. Most fatal injuries result from high-voltage exposure; however, people can sustain severe injuries from low voltage power if it has a high current flow. Electrical safety is important in every work environment. The following sections cover circuit breaker loads, electrical grounding, electrical safety guidelines, and electrical emergency response.

2.0 Definitions

2.1 The following definitions help clarify general electrical safety:

- 2.1.1 Amps: The standard unit for measuring electrical current.
- 2.1.2 Watt: A unit of electrical power, equal to the power developed in a circuit by a current of amp flowing through a potential difference of one volt.
- 2.1.3 Voltage: Electromotive force expressed in volts.
- 2.1.4 Circuit Breaker: A device that automatically interrupts the flow of an electrical current.
- 2.1.5 Breaker Box: An insulated box on which interconnected circuits are mounted.
- 2.1.6 Electrical Panel: An insulated panel on which electrical wires are mounted.
- 2.1.7 Current Flow: The rate of flow of an electrical charge, generally expressed in amps.
- 2.1.8 Electrical Load: The amount of power delivered by a generator or carried by a circuit. A device to which the power is delivered.
- 2.1.9 Ground-Fault Circuit Interrupter (GFCI): A GFCI detects grounding problems and shuts electricity off to prevent a possible accident.
- 2.1.10 High Voltage: The term high voltage applies to electrical equipment that operates at more than 600 Volts (for terminal to terminal operation) or more than 300 Volts (for terminal to ground operation). Low voltage, high current AC or DC power supplies are also considered to be high voltage.
- 2.1.11 Hazardous Energy Sources: This term applies to stored or residual energy such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure.

2.1.12 Lockout: The placement of a lock on an energy-isolating device. This act prevents workers from operating a piece of equipment until the lock is removed.

2.1.13 Tagout: The placement of a tag on an energy-isolating device. A tagout device is a prominent warning device of a lockout.

2.1.14 Energy-Isolating Device: A mechanical device that prevents the transmission or release of energy. Examples include the following:

2.1.14.1 Manually operated circuit breakers

2.1.14.2 Disconnect switches

2.1.14.3 Line or block valves

2.1.15 Pushbuttons, selector switches, and other control circuit devices do not isolate energy. Energy-isolating devices should be lockable by means of a hasp or other type of attachment. It should not be necessary to dismantle or reassemble a device to lock it.

2.1.16 Authorized Employee: A person who locks out or tags out equipment for service or maintenance. Authorized employees have been formally trained in proper lockout/tagout procedures.

3.0 Circuit Breaker Loads

3.1 Most office and laboratory locations have 20 amp circuit breakers that serve two or more outlets. These breakers can handle most office equipment; however, the widespread use of personal computers and associated hardware can create an electrical overload. To determine your current electrical load, follow these steps:

3.1.1 Check office/laboratory equipment for a manufacturer's rating label that indicates total watts or amps. Take special care to check appliances that use electricity to generate heat.

3.1.2 Convert the watts rating to amps:

3.1.2.1 Amps = Watts ÷ Voltage (typically 120 Volts)

3.1.3 Total the amps for each circuit.

3.1.4 If the total equals more than 15 amps per 20 amp circuit, you may be overloading the circuit. Move enough equipment to a different circuit to reduce the circuit load; otherwise, have the Physical Plant inspect the circuit wiring.

4.0 Electrical Grounding

4.1 Proper electrical grounding can help prevent electrical injury. Most electrical equipment is grounded with either a three-prong plug or a two-prong plug and insulation. Because a grounding system may be defective without your knowledge, use a GFCI to ensure electrical safety. GFCIs are required in moist or potentially damp environments, near water sources, etc. Contact Physical Plant for assistance if a GFCI may be needed.

5.0 Electrical Panels

5.1 Electrical panels or breaker boxes require special safety considerations, including the following:

- 5.1.1 Know where your panel box is located.
- 5.1.2 Do not tape circuit switches to keep a breaker from tripping.
- 5.1.3 Ensure that breaker circuits are accurately labeled within panel boxes.
- 5.1.4 Ensure that panel box doors are securely attached.
- 5.1.5 Do not block panel boxes. There should be at least 30 inches of clear space in front of a panel box.
- 5.1.6 Make sure there are no missing pop-outs on the electrical panel.

5.2 Reports tripped breakers and refer any electrical questions to the Physical Plant.

6.0 Electrical Safety Guidelines

6.1 Follow these guidelines for general electrical safety:

- 6.1.1 Be familiar with the electrical hazards associated with your workplace.
- 6.1.2 Unplug electrical equipment before repairing or servicing it.
- 6.1.3 If a prong breaks off inside an outlet, do not attempt to remove it yourself. Call the Physical Plant for assistance.
- 6.1.4 Ensure that outlets are firmly mounted. Report loose outlets to the Physical Plant.
- 6.1.5 Report all electrical problems, including tripped breakers, broken switches, and flickering lights, to the Physical Plant.
- 6.1.6 All appliances used in TAMU buildings must be UL or FM (Factory Mutual) labeled.

6.1.7 Do not use an appliance that sparks, smokes, or becomes excessively hot, unless the appliance is specifically designed to exhibit these characteristics.

6.1.8 Portable electrical heaters are discouraged for reasons of energy conservation. However, if approved by a supervisor, they must be placed to avoid causing a trip hazard and must be kept away from combustible material. Never leave a heater unattended. Unplug the heater at the end of the day or when not in use.

6.1.9 Keep electrical equipment away from water, unless the appliance is specifically designed for use around water, such as a wet-dry shop vacuum.

6.1.10 Use GFCIs whenever possible.

6.1.11 Be aware of overhead power lines when working with tall equipment (e.g., grain augers, cranes, sailboats, etc.).

6.1.12 Follow lockout/tagout procedures, as appropriate. Refer to Section 8.0 below.

6.2 Follow these guidelines for electrical plug and cord safety:

6.2.1 Do not remove the prongs of an electrical plug. If plug prongs are missing, loose, or bent, replace the entire plug or the cord and plug.

6.2.2 Do not use an adapter or extension cord to defeat a standard grounding device. (i.e., only place three-prong plugs in three-prong outlets; do not alter them to fit in a two-prong outlet.)

6.2.3 Use extension cords only when necessary and only on a temporary basis. Do not use extension cords in place of permanent wiring. Request new outlets if your work requires equipment in an area without an outlet.

6.2.4 Use extension cords that are the correct size or rating for the equipment in use. The diameter of the extension cord should be the same or greater than the cord of the equipment in use.

6.2.5 Do not run electrical cords above ceiling tiles or through walls.

6.2.6 Keep electrical cords away from areas where they may be pinched and areas where they may pose a tripping or fire hazard (e.g., doorways, walkways, under carpet, etc.)

6.2.7 Avoid plugging more than one appliance in each outlet. If multiple appliances are necessary, use an approved power strip with surge protector and circuit breaker. Do not overload the circuit breaker.

6.2.8 Discard damaged cords, cords that become hot, or cords with exposed wiring.

6.2.9 Never unplug an appliance by pulling on the cord; pull on the plug.

6.2.10 Always unplug and secure an extension cord when not it use.

7.0 Electrical Emergency Response

7.1 The following instructions provide guidelines for handling three types of electrical emergencies:

7.1.1 Electric Shock: When someone suffers serious electrical shock, he or she may be knocked unconscious. If the victim is still in contact with the electrical current, immediately turn off the electrical power source. If you cannot disconnect the power source, try to separate the victim from the power source with a nonconductive object, such as a wood-handled broom.

7.1.2 ***IMPORTANT:*** *Do not touch a victim that is still in contact with a power source; you could electrocute yourself.*

7.1.3 Have someone call for emergency medical assistance immediately. Administer first-aid, as appropriate.

7.1.4 Electrical Fire: If an electrical fire occurs, try to disconnect the electrical power source, if possible. If the fire is small, you are not in immediate danger, and you have been trained in fighting fires, use any type of fire extinguisher **except water** to extinguish the fire.

7.1.5 ***IMPORTANT:*** *Do not use water on an electrical fire. Instead use a fire extinguisher approved for electrical fire use.*

7.1.6 Power Lines: Stay away from live power lines and downed power lines. Be particularly careful if a live power line is touching a body of water. The water could conduct electricity. If a power line falls on your car while you are inside, remain in the vehicle until help arrives.

8.0 Lockout/Tagout Procedures

8.1 Texas A&M Environmental Health & Safety Lockout/Tagout Program

8.1.1 Failure to Follow Proper Procedures When Using the Lockout/Tag-out System Will Result In Disciplinary Action

8.2 Preplanning for Lockout (Preparation for Shutdown)

An initial survey shall be made to determine which switches, valves, or other energy isolating devices apply to the equipment being locked out. More than one energy source (electrical, mechanical, hydraulic, pneumatic, chemical, thermal, or others) may be involved. Any questionable identification of sources shall be cleared by the employees with their supervisors. Before lockout commences, job authorization should be obtained from the supervisor.

8.2.1 Only supervisors or authorized individuals shall prescribe the appropriate duties and responsibilities relating to the actual details of affecting the lockout/tag-out. Energy isolating devices shall be operated only by authorized individuals or under the direct supervision of authorized individuals. Where high voltages greater than 480V are involved the supervisor electrician shall be responsible for turning off the main power controls.

8.2.2 All energy isolating devices shall be adequately labeled or marked to indicate their function. The identification shall include the following:

8.2.2.1 Equipment supplied
8.2.2.2 Energy type and magnitude

8.2.3 Where system complexity requires, a written sequence in checklist form should be prepared for equipment access, lockout/tag-out, clearance, release, and start-up.

8.3 Lockout/Tag-out Procedures preparation

8.3.1 Notify all affected employees/ building occupants that a lockout is required and the reason therefore.

8.3.2 Contact necessary departments and personnel

8.3.3 Only authorized personnel are to secure lockout/tag-out device. Authorized personnel include managers, shop supervisors, area maintenance supervisors.

8.3.4 Machine or Equipment Shutdown

8.3.4.1 If the equipment is operating, shut it down by the normal stopping procedure (depress stop button, open toggle switch, etc.). Disconnect switches should never be pulled while under load, because of the possibility of arcing or even explosion. Personnel knowledgeable of equipment operation should be involved with shut down or re-start procedures.

8.3.5 Machine or Equipment Isolation

8.3.5.1 Operate the switch, valve, or other energy-isolating device so that the energy source(s) (electrical, mechanical, hydraulic, etc.) is (are) disconnected or isolated from the equipment. Stored energy, such as that in capacitors, springs, elevated machine members, rotating flywheels, hydraulic systems, and air, gas, steam, or water pressure, etc., must also be dissipated, disconnected, or restrained by methods such as grounding, repositioning, blocking, bleeding-down, etc. Pulling a fuse is not a substitute for locking out. A pulled fuse is no guarantee the circuit is dead, and even if it were dead, there's nothing to stop someone from inadvertently replacing the fuse.

8.3.5.2 CAUTION: Intermittently operating equipment such as pumps, blowers, fans, and compressors may seem harmless when dormant. Don't assume that because equipment isn't functioning, it will stay that way.

8.3.6 Application of Lockout/Tag-out

8.3.6.1 Lockout and tag the energy isolating device with an assigned individual lock, even though someone may have locked the control before you. You will not be protected unless you put your own padlock on it. For some equipment it may be necessary to construct attachments to which locks can be applied. An example is a common hasp to cover an operating button. Tags shall be attached to the energy isolating device(s) and to the normal operating control and shall be attached in such a manner as to preclude operation.

8.3.7 Verification of Isolation

8.3.7.1 After ensuring that no personnel can be exposed and as a check on having disconnected the energy sources, operate the push button or

other normal operating controls to make certain the equipment will not operate.

8.3.7.2 If there is a possibility of re-accumulation of stored energy to a hazardous level, verification of isolation shall be continued until the maintenance or repair is completed, or until the possibility of such accumulation no longer exists.

8.3.7.3 CAUTION: Return operating controls to neutral position after the test. A check of system activation (e.g. use of voltage indicator for electrical circuits) should be used to assure isolation.

8.3.8 The equipment is now locked out.

8.4 Release from Lockout/Tag-out

8.4.1 Before lockout or tag-out devices are removed and energy is restored to the machine or equipment, inspect the work area to ensure that nonessential items have been removed and to ensure that machine or equipment components are operationally intact.

8.4.2 Check work area to ensure that all employees are in the clear. Notify affected employees that lockout/tag-out devices have been removed.

8.4.3 The employee who applied the device shall remove each lockout/tag-out device from each energy-isolating device. The energy isolating devices may be opened or closed, to restore energy to equipment.

8.4.4 Contact authorized personnel when energy is restored and return lockout/tag-out device. (Proper Documentation Required)

8.5 Lockout/Tag-out Interruption (Testing of Energized Equipment)

8.5.1 In situations where the energy isolating device(s) is lockout/tagged and there is a need for testing or positioning of the equipment/process, the following sequence shall apply:

8.5.1.1 Make sure to Clear equipment and/or process of tools and materials.

8.5.1.2 Make sure all personnel are clear of danger.

8.5.1.3 Remove the control of locks/tags according to established procedure.

8.5.1.4 Proceed with test, etc.

8.5.1.5 De-energize all systems and re-lockout /re-tag-out the controls to continue the work.

8.6 Procedure Involving More Than One Person

8.6.1 In the preceding steps, if more than one individual is required to lock out equipment, each shall place a personal lock and tag on the group lockout device when he/she begins work, and shall remove those devices when he/she stops working on the machine or equipment. The supervisor, with the knowledge of the crew, may lock out equipment for the whole crew. In such cases, it shall be the responsibility of the supervisor to carry out all steps of the lockout procedure and inform the crew when it is safe to work on the equipment. Additionally, the supervisor shall not remove a crew lock until it has been verified that all individuals are clear.

8.6.2 Scheduled Leave

8.6.2.1 If the owner of the device (owner being the person who installed the lockout/tag- out device) is going on scheduled leave and someone else may need to work on the locked out unit, they must remove their lock and have it replaced by a new owner who is on regular duty.

8.7 Conditions for lockout/tag-out removal by Authorized Personnel

8.7.1 Only the owner of the device shall remove lockout/tag-out devices.

8.7.2 Exceptions to the conditions of removal:

8.7.2.1 Owner incapacitated by illness or injury then his/her supervisor shall remove the lockout/tag-out devise.

8.7.2.2 Owner is no longer is employed by Texas A&M University, then his/her supervisor shall remove the lockout/tag-out devise.

8.7.2.3 If Authorized Personnel determines that circumstances warrant removal of a lockout/tag-out device, every effort must be made to contact the owner of the device. After the above conditions have been met the Authorized Personnel may remove device.

9.0 High Voltage Procedures

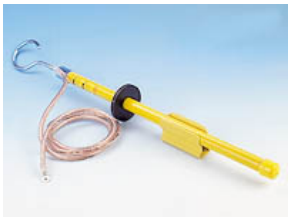
9.1 In addition to the guidelines associated with general electrical safety and lockout/tagout procedures, there are more stringent safety requirements for high voltage procedures.

9.2 The following list provides high-voltage safety tips. For more information, please refer to Title 29 Section 1910.269 of the Code of Federal Regulations or NFPA 70 (National Electric Code).

9.2.1 Ensure that only authorized employees work around high voltage equipment.
9.2.2 Label entrances with a High Voltage Sign.
9.2.3 Ensure that terminal voltage ratings can withstand surges caused by electrical faults or switching transients.
9.2.4 Be careful around output circuits even when the input power is off. Parallel power sources and energy storage devices can still be dangerous.
9.2.5 Be careful when working with power supplies that serve more than one area.
9.2.6 Before working in a high voltage area, inspect the power supply and check all protective devices.
9.2.7 Do not work alone near high voltage.
9.2.8 Label equipment to identify power sources. Label input power sources to identify connected power supply loads.
9.2.9 Attach emergency shutdown instructions and phone numbers to equipment that is remotely controlled or unattended while energized.

9.3 Before entering a power supply or associated equipment enclosure to work on hazardous energy sources, complete the following:

9.3.1 De-energize the equipment.
9.3.2 Open and lockout the main input power circuit breaker.
9.3.3 Check for auxiliary power circuits that could still be energized.
9.3.4 Inspect automatic shorting devices for proper operation.
9.3.5 Short the power supply with grounding hooks.



10.0 Minimum Clear Working Space

10.1 The following table from the National Electric Code provides minimum depth of clear working space in front of electrical equipment :

10.1.1 Where conditions (i), (ii), and (iii) are as follows:

10.1.1.1 (i) Exposed live parts on one side and no live or grounded parts on the other side of the working space, or exposed live parts on both sides effectively guarded by suitable wood or other insulating materials. Insulated wire or insulated bus bars operating at not over 300 volts shall not be considered live parts.

10.1.1.2 (ii) Exposed live parts on one side and grounded parts on

The other side. Concrete, brick, or tile walls will be considered as grounded surfaces.

10.1.1.3 (iii) Exposed live parts on both sides of the workspace [not guarded as provided in condition (i)] with the operator between.

END OF SECTION