

Technician License Course
Chapter 9.1
Lesson Module 20:
Electrical Safety

<http://www.arrl.org/chpt-9-safety>

Electrical Safety

9-1

- Avoiding contact is the most effective way of practicing electrical safety.
- Most modern radio equipment use currents that are not as dangerous as older equipment but precautions still must be taken.

Electrical Injuries

9-2

- Shocks.
- Burns.
- Even small currents can cause problems.

Table 9.1

Effects of Electric Current in the Human Body

Current	Reaction
Below 1 milliampere	Generally not perceptible
1 milliampere	Faint tingle
5 milliamperes	Slight shock felt; not painful but disturbing. Average individual can let go. Strong involuntary reactions can lead to other injuries.
6-25 milliamperes (women) 9-30 milliamperes (men)	Painful shock, loss of muscular control*; the freezing current or "can't let-go" range.
50-150 milliamperes	Extreme pain, respiratory arrest, severe muscular contractions. Death is possible.
1000-4300 milliamperes	Rhythmic pumping action of the heart ceases. Muscular contraction and nerve damage occur; death likely.
10,000 milliamperes	Cardiac arrest, severe burns; death probable

* If the extensor muscles are excited by the shock, the person may be thrown away from the power source.

Source: W.B. Kouwenhoven, "Human Safety and Electric Shock," Electrical Safety Practices, Monograph, 112, Instrument Society of America, p 93. November 1968.

[T0A02]

Mitigating Electrical Hazards

9-2

- Turn off power when working inside equipment!
- Make sure equipment is properly grounded and circuit protected!
- Keep one hand in pocket when working around high voltage circuits.

Mitigating Electrical Hazards

- If power is required:
 - Remove jewelry.
 - Avoid unintentional touching of circuitry.
 - Never bypass safety interlocks.
 - Capacitors hold a charge even when power is off. [T0A11]
 - Storage batteries are dangerous when shorted. [T0A01]

Responding to Electrical Injury 9-3

- **REMOVE POWER!**
 - Have ON/OFF switches and circuit breakers clearly marked.
- Call for help.
- Learn CPR and first aid.

Electrical Grounding and Circuit Protection (in the home)

9-3

- Make sure your home is “up to code.”
- Most home equipment does not require special wiring or circuits. [T0A06]
 - Use 3-wire power cords.
 - Use circuit breakers, circuit breaker outlets, or Ground Fault Circuit Interrupter (GFCI) circuit breakers or outlets
 - Use proper fuse or circuit breaker size. Table 9-2.
 - Don’t overload single outlets.
 - Install a fuse or circuit breaker in the ac hot (black) on any home brew equipment [T0A08]

Electrical Standards

Follow standard wiring rules

Use proper wire and fuse size

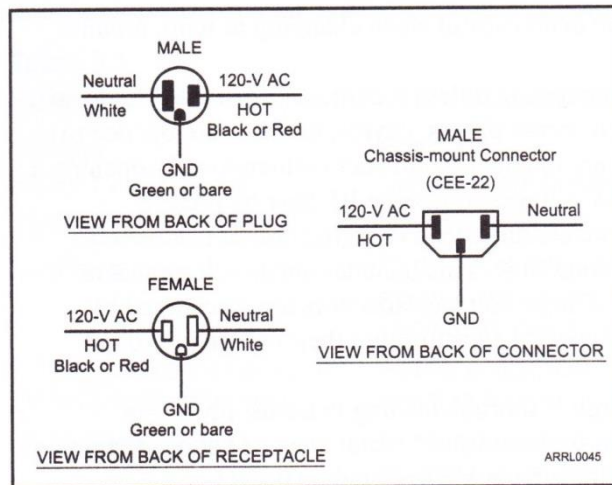


Figure 9.1 — The correct wiring technique for 120 V ac power cords and receptacles. The white wire is neutral and the green wire is the safety ground. The hot wire can be either black or red. These receptacles are shown from the back, or wiring side.

Table 9.2

Current-Carrying Capability of Some Common Wire Sizes

Copper Wire Size (AWG)	Allowable Current (A)	Max Fuse or Circuit Breaker (A)
6	55	50
8	40	40
10	30	30
12	25 (20) ¹	20
14	20 (15) ¹	15

¹The National Electrical Code limits the fuse or circuit breaker size (and as such, the maximum allowable circuit load current) to 15 A for #14 AWG copper wire and to 20 A for #12 AWG copper wire conductors.

[T0A03]

Lightning Safety

9-4

- Antennas are not struck any more frequently than trees or tall structures.
- Ground all antennas, towers, masts and antenna mounts according to local building codes. [T0B11]
- Use lightning arrestors where cable and feed lines enter the house.
- Ground lightning arrestor to a common plate which is grounded to a nearby external ground such as a ground rod [T0A07]
- Ground connections should as short and direct as possible. [T0B12]
- Avoid sharp bends in ground cables [T0B10]
- Disconnect antenna cables and power cords during storms.
- Disconnect telephone lines from computer modems.
- Disconnect AC power from power supplies.

What is a commonly accepted value for the lowest voltage that can cause a dangerous electric shock? (T0A01)

- * A. 12 volts
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How does current flowing through the body cause a health hazard? (T0A02)

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- * B. It disrupts the electrical functions of cells
- * C. It causes involuntary muscle contractions
- * D. All of these choices are correct

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What is a good way to guard against electrical shock at your station? (T0A06)

- * A. Use three-wire cords and plugs for all AC powered equipment
- * B. Connect all AC powered station equipment to a common safety ground
- * C. Use a circuit protected by a ground-fault interrupter
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Which of these precautions should be taken when installing devices for lightning protection in a coaxial cable feedline? (T0A07)

- * A. Include a parallel bypass switch for each protector so that it can be switched out of the circuit when running high power
- * B. Include a series switch in the ground line of each protector to prevent RF overload from inadvertently damaging the protector
- * C. Keep the ground wires from each protector separate and connected to station ground
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Which of the following is good practice when installing ground wires on a tower for lightning protection? (T0A11)

- * A. Put a loop in the ground connection to prevent water damage to the ground system
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What kind of hazard might exist in a power supply when it is turned off and disconnected? (T0A12)

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- * B. Circulating currents inside the transformer might cause damage
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What safety equipment should always be included in home-built equipment that is powered by 120V AC power circuits? (T0A13)

- * A. A fuse or circuit breaker in series with the AC “hot” conductor
- * B. An AC voltmeter across the incoming power source
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Which of the following is true concerning grounding conductors used for lightning protection? (T0B10)

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- * B. Wires must be carefully routed with precise right-angle bends
- * C. Sharp bends must be avoided
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- * A. FCC Part 97 Rules
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- * D. Underwriters Laboratories' recommended practices

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