Safety and Tools

Lesson 4

Effective communication with your customer and knowing the troubleshooting process enables you to start and get acquainted with the proper tools and safety measures in troubleshooting. To continue troubleshooting, though, you need to be skillful when handling the computer. That starts with knowing how to handle computer components safely and how to use the tools of a PC technician. Let's begin by identifying and discussing some of the problems you may run into and how to deal with them.

Safety Matters

When working on computers, it's important to pay attention to safety considerations. A basic premise to always keep in mind is that computers are just things that can be replaced, but we can't replace people. In other words, value people first when working with computers. By following basic safety precautions, you can prevent damage to people and to equipment.

Electrical Safety

Unless you're measuring voltages within a computer, you should never work on computers without first removing power. This includes turning the computer off and unplugging it.

Just turning off the power is not enough. ATX-based power supplies provide power to the motherboard even if the front power switch on the computer indicates that it is turned off. If you want to ensure that the computer does not have any power, unplug the power supply.

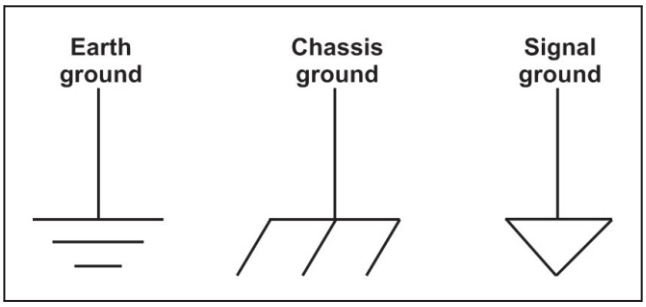
Most people consider PSUs modular units. In other words, if the PSU fails you simply replace it instead of trying to repair it. However, if you do open the power supply, don't forget the following two important warnings:

- Never open it when it is plugged in.
- Even after you unplug it, capacitors within the power supply will hold a charge. If you touch the capacitor, it can easily discharge and shock you.

Equipment and Self Grounding

In electronics, ground refers to a path to Earth. A copper cable is attached to a spike and hammered into the ground. The other end of this cable is available in the electrical system and identified as a ground. Most electrical equipment includes circuitry that will automatically redirect any dangerous voltages to ground to prevent shocks.

Ground is referred to differently based on the location of the connection. For example, the image below shows the three primary symbols used for ground.



Ground Symbols Diagram

Earth ground is the path directly to Earth. Chassis ground refers to the path to the equipment case or chassis. Signal ground refers to the return path for a signal. Signal ground connections are commonly connected to the chassis. For example, some screws connecting a motherboard to a computer case connect the motherboard signal ground to the case. The chassis ground is then connected to the Earth ground via the power cable.

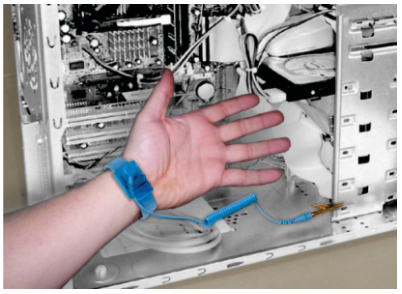
Electronic Static Discharge (ESD)

Static electricity builds up on different types of objects, and when one object touches another, the static discharges. You've probably experienced a static discharge after walking across a carpeted floor and touching a doorknob. This is also called electrostatic discharge (ESD).

The shock you felt might have been unpleasant, but it wasn't harmful. However, it can be damaging to computers. If you felt it, at least 3,000 volts were discharged from your hand to the doorknob. If you actually saw the spark when it discharged, it was at least 8,000 volts. The good news is these voltages won't kill or hurt people, mostly because they aren't combined with current to generate power.

In contrast, computer components can be damaged by as little as 250 volts. You won't see it. You won't feel it. However, the damage will be real.

The primary way to prevent ESD damage is by ensuring that the worker and the equipment are at the same ground potential. Steps you can take to reduce ESD damage include the following:



Anti-Static Wrist Strap in use

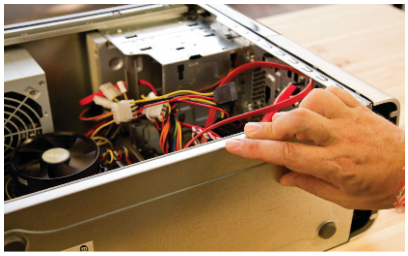
- **Use an ESD wrist strap**. An *ESD wrist strap* wraps around your wrist and has a metal component touching your skin. A wire leads from the strap to an alligator clip that you can clip to the computer case. This results in you and the case being at the same potential, and it prevents static discharge. On work benches, ESD straps are used to connect the equipment case to a grounding bar that is connected to Earth ground. The technician can connect alligator clips from the wrist strap to the case or to the grounding bar as shown in the picture(right).

Anti-Static bag

- **Use antistatic bags**. When storing and transporting electronic components, they should be stored in *antistatic bags*. These bags help prevent static from building up and causing ESD damage to the components, shown in the image on the right.

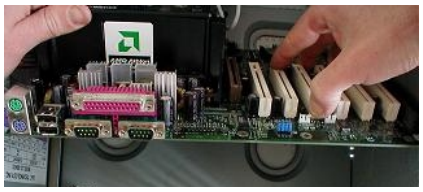
ESD Mat & Wrist strap combination

- **Use ESD mats**. Special *ESD mats* prevent static buildup, and they are commonly used on work benches. Technicians place computers on the antistatic mat while working on them. Larger antistatic mats can be placed on the floor in front of the technician's bench to reduce static.



A Tech that self-ground himself

- **Self-grounding.** If you touch the computer case before working on any components, built-up static will discharge harmlessly onto the case. This ensures that your body is at the same ground potential as the case. Additionally, if you keep your feet stationary after touching the case, it reduces the chances for static to build up. See picture(left) shown.



Proper way of removing computer parts

- **Don't touch components or pins.** If you remove any circuit cards, don't touch the components or the pins. Instead, hold the outside edges or the plastic handles, see picture(left) how it is done.

- Control humidity. When the humidity is very low, static builds up more quickly. If you live in a colder area, you will notice that static is more common in the winter because heating systems remove humidity from the air. In contrast, when the humidity is higher, the static charges dissipate naturally. Ideally, humidity should be around 50 percent. The images(right) are examples of static in hands.

- Don't place computers on carpets. Static can build up on carpets more easily than on other floor surfaces. You've probably noticed that in a heated building you can shuffle your feet over a carpet to quickly build up static. This doesn't work on tile floors or other floor surfaces.

Fire Safety

Fires are classified based on what is burning, and fire extinguishers are classified based on what fires they can safely extinguish. The four primary types of fires are as follows:

- **Class A**. This type of fire involves ordinary combustible material such as paper and wood. The fire can be extinguished with water or a Class A fire extinguisher.
- **Class B**. This type of fire involves flammable liquids and gases. Class B fire extinguishers use chemicals to disrupt the chemical reaction, or they smother the fire with a gas such as carbon dioxide. Spraying water on a Class B fire is dangerous because it will spread the fire instead of extinguishing it.
- **Class C**. An electrical fire is a Class C fire, and the best way to extinguish it is by removing the power source. For example, unplugging it or turning off the circuit breaker can stop the fire. Class C fire extinguishers use special chemicals such as Purple-K or carbon dioxide to extinguish a fire.
- **Class D**. This type of fire involves combustible metals. A Class D fire extinguisher uses special chemicals to smother the fire. Water should not be used.

Physical Safety

Lifting

When lifting equipment, it's best to lift with your legs, not your back. In other words, instead of bending down to pick up heavy equipment, you should squat, bending your knees, to pick it up.

There aren't any firm guidelines on safe weight limitations. However, it's generally recommended that individuals will not try to lift equipment weighing more than 70 pounds without help. Instead use a box cart to move or lift the object(s).

Tech using box cart

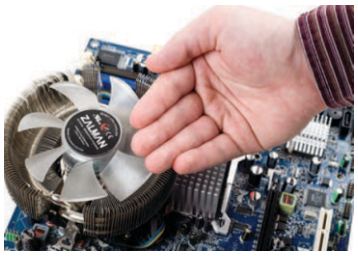
Tripping Hazard

Technicians live in a dangerous world. They are in constant danger of tripping. The picture(right) shows a typical corner of any office, a painful example of a cable "kludge" . Cable messes such as these are dangerous tripping hazards. Most offices and in a business environment cables are carefully tucked away behind computer cases, run into walls, or placed under cable runners. If you see a cable that is an obvious tripping hazard, contact the person in charge of the building maintenance to take care of it immediately. The results of ignoring such hazards can be catastrophic.

Messy cables

Hot components & Hang-loose objects

You also need to watch out for hot components. First, watch for anything with a cooling fin like the one shown in the picture(right). If you see a cooling fin, surely it is hot enough to burn you. Also look for labels or stickers warning about hot components. Last, when in doubt, move your hand over components as if you were checking the heat on a stove. Finally, remove any jewelry or loose-hanging clothing before working on a computer. If you have long hair, you might consider tying it back in a ponytail. You don't want anything getting caught in a fan or stuck on a component. This can save you and your components from being damaged.

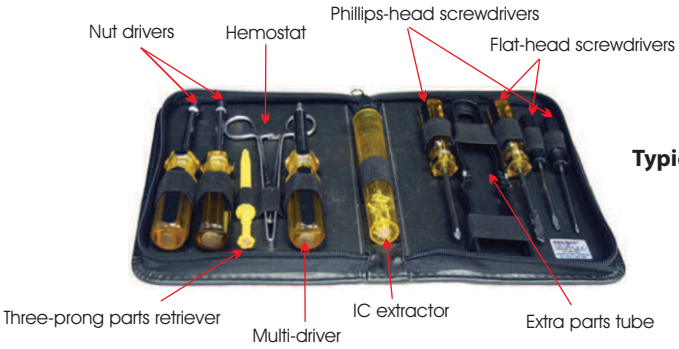


Hot fin/sink with fan

Tools of the Trade

The basic technician's toolkit consists of a Phillips-head screwdriver and a half-dozen tools that make a fully functional toolkit. Most kits have a star-headed Torx wrench, a nut driver or two, a pair of plastic tweezers, a little grabber tool (the technical term is *parts retriever*), a hemostat, an IC extractor for removing various chips, and both Phillips head and flat-head screwdrivers as shown in the picture below.

Screwdrivers & more



Typical technician toolkit

Extension Magnet

Most technicians throw in an extension magnet to grab hard-to-reach bits that drop into cases It's not uncommon to drop a screw within a system, but your fingers often won't fit into the small spaces to retrieve it. You can retrieve it with an extension magnet. An extension magnet has a handle similar to a screwdriver, but it has an extendable wand with a magnet on the enc In some situations, the screw might fall onto other electrical components, such as the motherboard. Instead of using the extension magnet, you can use a pair of plastic tweezers to avoid possible damage to system components.

Extension magnet

Magnifying Glass & Flashlight

Many also add a *magnifying glass* and a *flashlight* for those hard-to-read numbers and text on the printed circuit boards (PCBs) that make up a large percentage of devices inside the system unit.

Magnifying glass & Flashlight

Multimeter

Multimeter

Multimeters have multiple functions, and technicians commonly use them to measure power supply voltages.

For example, power supplies sometimes lose the ability to provide constant power. Instead of a steady 12 V, a power supply might waver between 10 V and 14 V. Even though a system has some tolerance for variations, generally anything beyond 5 percent can cause problems, such as random restarts. Therefore, the 12-V line should not waver more than plus or minus 0.6 V (11.2 V to 12.6 V). If you're experiencing random problems and suspect the power supply, you can use a multimeter to measure the voltages.

The picture(right) shows a multimeter set to the V setting. It can measure both DC and AC voltages by using this setting. Additionally, this is an autorange digital multimeter (DMM), meaning that it can automatically sense the voltage range.

Also in the picture(top right) you can see that the multimeter has two probes. It might not be apparent in the black-and-white picture, but one probe is red and one is black. You would connect the black probe to a ground pin of a connector (with a black wire) and connect the red probe to the voltage pin in the connector. For example, if you want to measure 12 V provided on a connector, connect it to the pin with the yellow wire. If you want to measure the 5-V line, connect the red probe to the pin with the red wire.

When taking voltage measurements, you should remove jewelry. If the jewelry touches a metal component that has voltage, it's possible to short it out and damage the equipment. It could also shock you.

Multimeters can also take other measurements. Besides voltage, the most common measurement is a continuity check. When the meter is set to do a continuity check, you can touch the probes together and the meter will beep, indicating a continuous connection. You can use this setting to check for a break in a cable. You touch one probe to the connector on one side of a cable, and the other probe to the other side. If it beeps, it indicates a continuous connection in the cable, indicating that the cable is good. If it doesn't beep, the cable has a break and should be replaced.

Computer Vacuum

In some cases, it isn't feasible to take computers outside to blow out the dust. However, if you blow out the dust inside the building, you're going to make quite a mess. Instead, you can use a computer *vacuum cleaner* to clean out the computer.

Vacuum Cleaner

You should use only vacuum cleaners designed for the job. Regular vacuum cleaners generate static electricity and can easily damage the sensitive components within the computer. Computer vacuums are made of special materials and often use batteries instead of AC power.

Power Supply Tester

Most power supplies will not provide voltages unless they are plugged into the component. For example, if you want to measure voltages on the motherboard P1 connector, the P1 connector needs to be plugged in. If it's not plugged in, the voltages are zero.

This can be a problem if you want to check a power supply but you don't have a motherboard or other components. However, a power supply tester simulates the load for a power supply and lets you know if you have a problem. You plug the power supply cables into the *power supply tester* and turn it on. The tester will display the voltages, and if any of the voltages are outside specifications, it will indicate the problem.

Digital Power Supply Tester

Analog Power Supply Tester

Chapter 1
Laboratory Manual

OPERATIONAL PROCEDURES for PC Tech

Laboratory Activities

1.01 How Computer Tech Should Be
1.02 Effectively Communicating
1.03 Preparing for the Technical Interview
1.04 Integrating Safety into the Workplace
1.05 Safeguarding Your IT Future - Becoming a Professional

Chapter Analysis and Written Test

Lab Activity 1.04 Integrating Safety into the Workplace

Demonstrating safety precautions at all times is one of the most important things you can do to protect yourself and your customers and impress your employer. This mostly involves using common sense, but you should also make sure to carefully read and put into practice the safety guidelines provided in the work text.

Many techs go into the field with the mindset that safety is not that important, but it can save your life and the lives of others.

Learning Objectives

In this lab, you will identify the safety hazards in the workplace and become more aware of guidelines that are useful in a PC environment.

At the end of this lab, you'll be able to

- explain ESD
- explain MSDS and various hazards
- explain proper equipment disposal procedures

Lab Materials and Setup

The materials you need for this lab are:

- a PC with Internet access(optional)
- a notepad
- presentation software, if possible, to present your findings

Let's Get the Lab Started

The electrostatic discharge (ESD) can cause permanent damage to some components and erase data on some storage devices. If you take this to heart and practice ESD safety measures as a PC tech early on, you will gain respect in the workplace and demonstrate that you care about your employer's investment.

Step 1 Research ESD, material safety data sheets (MSDSs), and how to dispose of old computer equipment properly, while typing results. You can use the Internet, magazines, tech articles, manuals,and so forth, but make sure you properly document where you find your information.

Step 2 Compile the data into a presentation type document. Include the following:

- pages that describe and define ESD, MSDSs, and proper disposal
- pictures of
    - various anti-static devices
    - samples of MSDSs
    - disposing of old, outdated computer devices
- a short video clip of either
    - a student wearing an anti-static wrist strap and installing components into a PC
    - how to fill out an MSDS
    - how to properly dispose of computer components
    - a bibliography page

Step 3 (If time permits) Students take turns presenting their report to the class to demonstrate their knowledge.