

# Hardware Tools

## General Tool Use

For every job there is the right tool. Make sure that you are familiar with the correct use of each tool and that the correct tool is used for the current task. Skilled use of tools and software makes the job less difficult and ensures that tasks are performed properly and safely.

A toolkit should contain all the tools necessary to complete hardware repairs. As you gain experience, you learn which tools to have available for different types of jobs. Hardware tools are grouped into four categories:

- ESD tools
- Hand tools
- Cleaning tools
- Diagnostic tools



## ESD Tools

There are two ESD tools: the antistatic wrist strap and the antistatic mat. The antistatic wrist strap protects computer equipment when grounded to a computer chassis. The antistatic mat

protects  
computer  
equipment by  
preventing  
static  
electricity  
from  
accumulating  
on the  
hardware or  
on the  
technician.



An antistatic wrist strap is used to prevent ESD damage to computer equipment.



An antistatic mat is used to stand on or to place hardware on to prevent static electricity from building up.

# Hardware Tools

## Hand Tools

Most tools used in the computer assembly process are small hand tools. They are available individually or as part of a computer repair toolkit. Toolkits range widely in size, quality, and price.



A flat head screwdriver is used to loosen or tighten slotted screws.



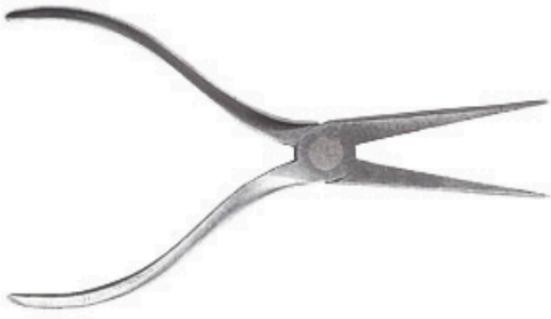
A Phillips head screwdriver is used to tighten or loosen cross-head screws.



A torx screwdriver is used to tighten or loosen screws that have a star-like depression on the top, a feature that is mainly found on laptops.



A hex driver, sometimes called a nut driver, is used to tighten nuts in the same way that a screwdriver tightens screws.



Needle-nose pliers are used to hold small parts.



Wire cutters are used to strip and cut wires.



Tweezers are used to manipulate small parts.



A part retriever is used to retrieve parts from locations that are too small for your hand to fit.



A flashlight is used to light up areas that you cannot see well.



A wire stripper is used to remove the insulation from wire so that it can be twisted to other wires or crimped to connectors to make a cable.



A crimper is used to attach connectors to wires.



A punch down tool is used to terminate wire into termination blocks. Some cable connectors must be connected to cables using a punch down tool.

## Cleaning Tools

Having the appropriate cleaning tools is essential when maintaining and repairing computers. Using the appropriate cleaning tools helps ensure that computer components are not damaged during cleaning.



A soft, lint-free cloth is used to clean different computer components without scratching or leaving debris.



Compressed air is used to blow away dust and debris from different computer parts without touching the components.



Cable ties are used to bundle cables neatly inside and outside of a computer.



A parts organizer is used to hold screws, jumpers, fasteners, and other small parts and prevents them from getting mixed together.

## Diagnostic Tools

### Digital Multimeter

A digital multimeter, as shown in Figure 1, is a device that can take many types of measurements. It tests the integrity of circuits and the quality of electricity in computer components. A digital multimeter displays the information on an LCD or LED.

A digital multimeter is used to test the integrity of circuits and the quality of electricity in computer components.



### Loopback Adapter

#### Loopback Adapter



A loopback adapter is used to test the basic functionality of computer ports.

A loopback adapter, as shown in Figure 2, also called a loopback plug, tests the basic functionality of computer ports. The adapter is specific to the port that you want to test.

### Toner Probe

The toner probe, as shown in Figure 3, is a two-part tool. The toner part is connected to a cable at one end using specific adapters, such as an RJ-45, coaxial, or metal

A toner probe is used to trace cables.

Toner Probe



clips. The toner generates a tone that travels the length of the cable. The probe part traces the cable. When the probe is in near proximity to the cable to which the toner is attached, the tone can be heard through a speaker in the probe.

### External Hard Drive Enclosure

Although an external hard drive enclosure, as shown in Figure 4, is not a diagnostic tool, it is often used when diagnosing and repairing computers. The customer hard drive is placed into the external enclosure for inspection, diagnosis, and repair using a known-working computer. Backups can also be recorded to a drive in an external enclosure to prevent data corruption during a computer repair.



An external enclosure houses a hard drive that can be used to diagnose a customer hard drive or a computer that does not boot. The external enclosure can also be used to create backups of a customer's hard drive.

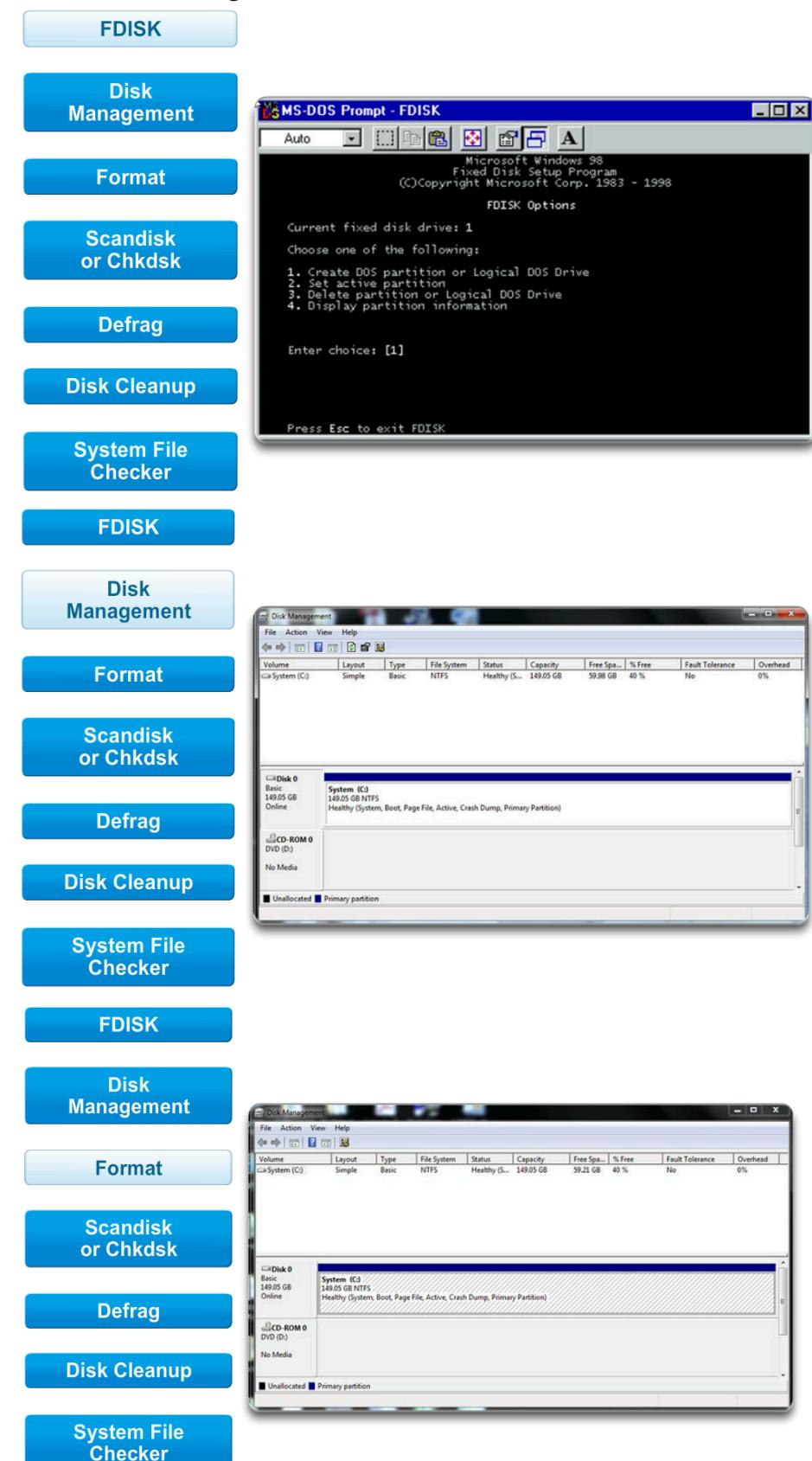
## Disk Management Tools

Software tools help diagnose computer and network problems and determine which computer device is not functioning correctly. A technician must be able to use a range of software tools to diagnose problems, maintain hardware, and protect the data stored on a computer.

You must be able to identify which software to use in different situations. Disk management tools help detect and correct disk errors, prepare a disk for data storage, and remove unwanted files.

The figure gives more information on the following disk management tools:

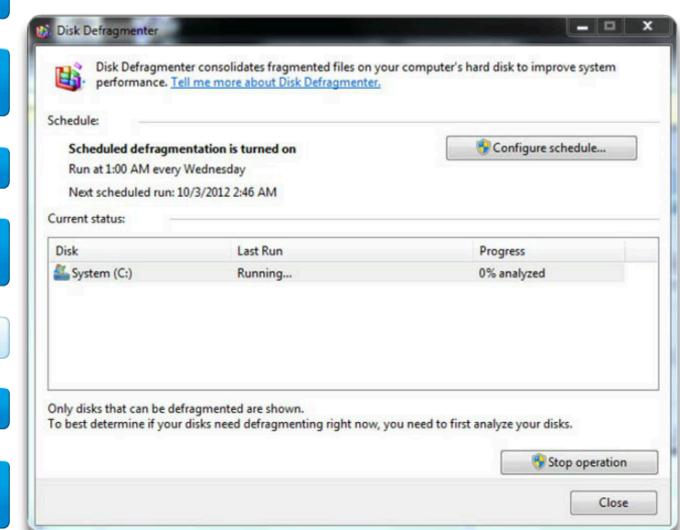
- **FDISK** - Creates and deletes partitions on a hard drive. The FDISK tool is not available in Windows XP, Vista, or 7. It has been replaced with the Disk Management tool.
- **Disk Management** - Initializes disks, creates partitions, and formats partitions.
- **Format** - Prepares a hard drive to store information.



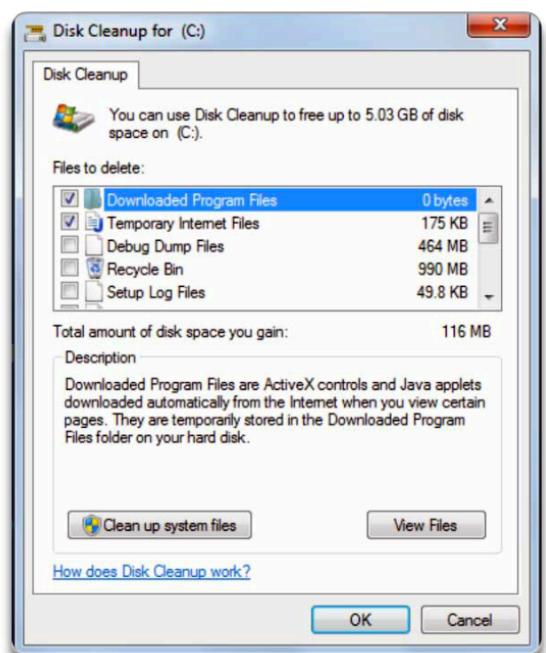
- **Scandisk or CHKDSK** - Checks the integrity of files and folders on a hard drive by scanning the file system. These tools might also check the disk surface for physical errors.



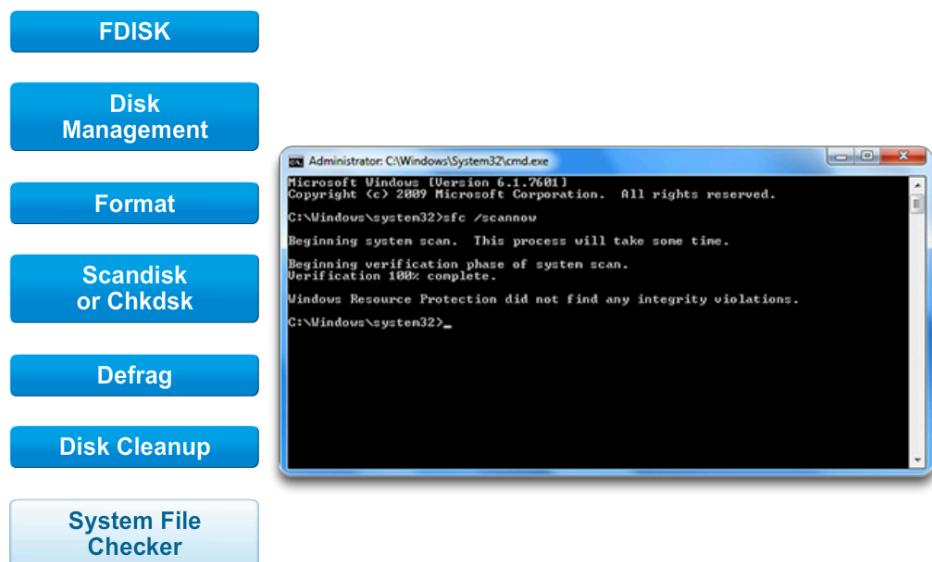
- **Defrag** - Optimizes space on a hard drive to allow faster access to programs and data.



- **Disk Cleanup** - Clears space on a hard drive by searching for files that can be safely deleted.



- System File Checker (SFC)** - Scans the operating system critical files and replaces files that are corrupted. Use the Windows 7 boot disk for troubleshooting and repairing corrupted files. The Windows 7 boot disk repairs Windows system files, restores damaged or lost files, and reinstalls the operating system. Third-party software tools are also available to assist in troubleshooting problems.



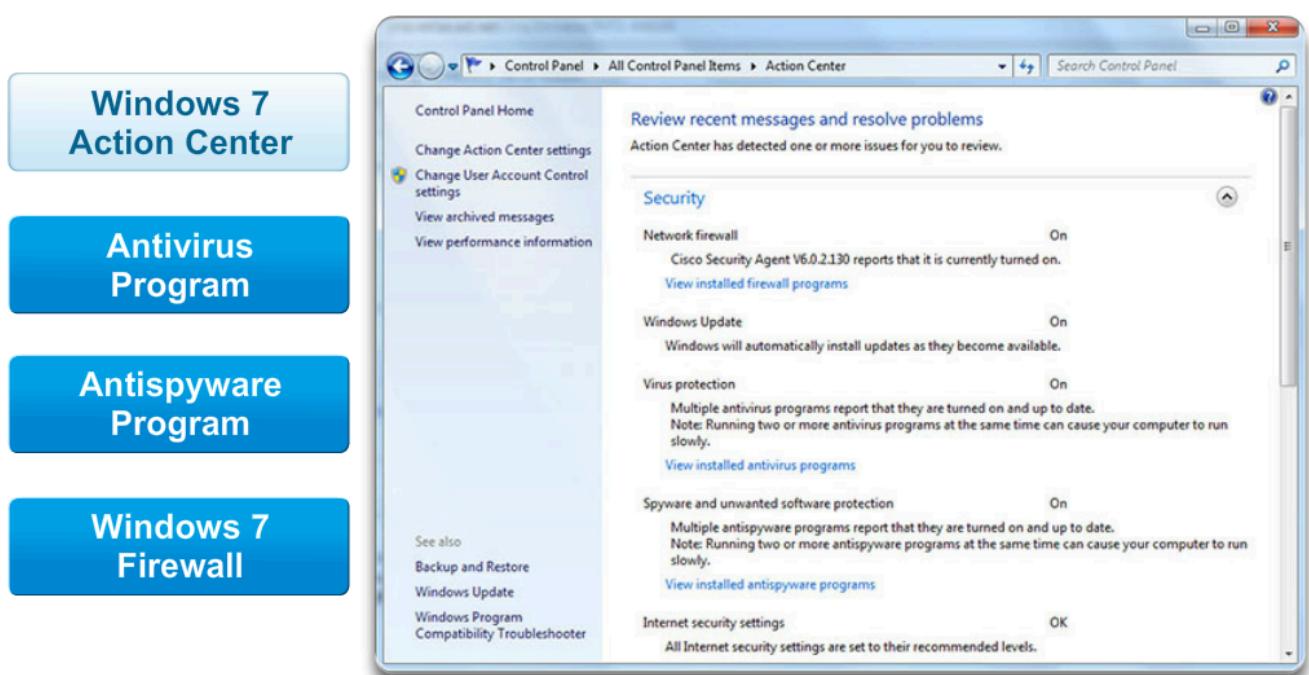
## Protection Software Tools

Each year, viruses, spyware, and other types of malicious attacks infect millions of computers. These attacks can damage operating systems, applications, and data. Computers that have been infected may even have problems with hardware performance or component failure.

To protect data and the integrity of the operating system and hardware, use software designed to guard against attacks and to remove malicious programs.

Various types of software protect hardware and data. The figure gives more information on these protection software tools:

- Windows 7 Action Center** - Checks the status of essential security settings. The Action Center continuously checks to make sure that the software firewall and antivirus programs are running. It also ensures that automatic updates download and install automatically.



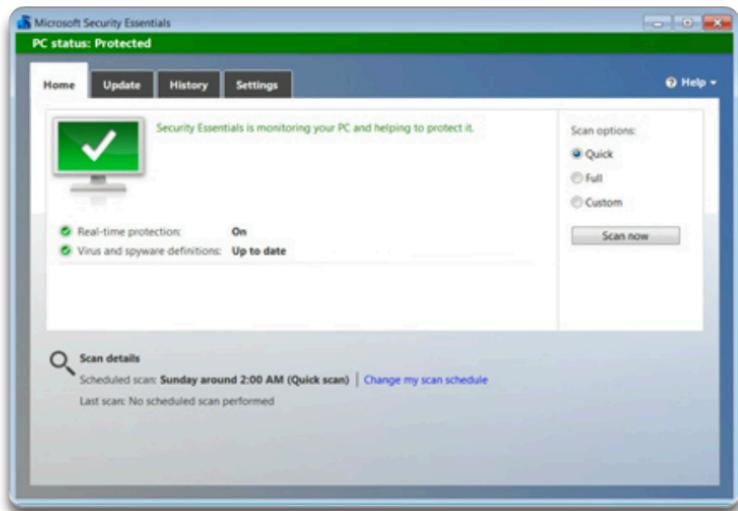
- **Antivirus program** - Protects against virus attacks.

**Windows 7 Action Center**

**Antivirus Program**

**Antispyware Program**

**Windows 7 Firewall**



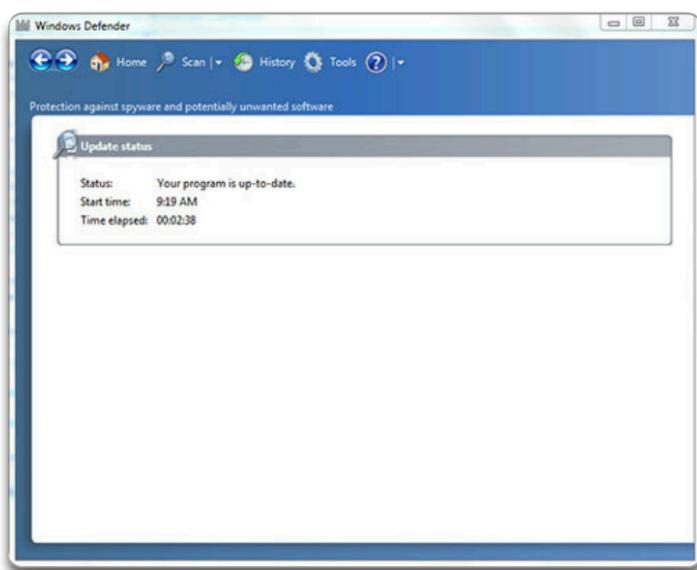
- **Antispyware program** - Protects against software that sends information about web surfing habits to an attacker. Spyware can be installed without the knowledge or consent of the user.

**Windows 7 Action Center**

**Antivirus Program**

**Antispyware Program**

**Windows 7 Firewall**



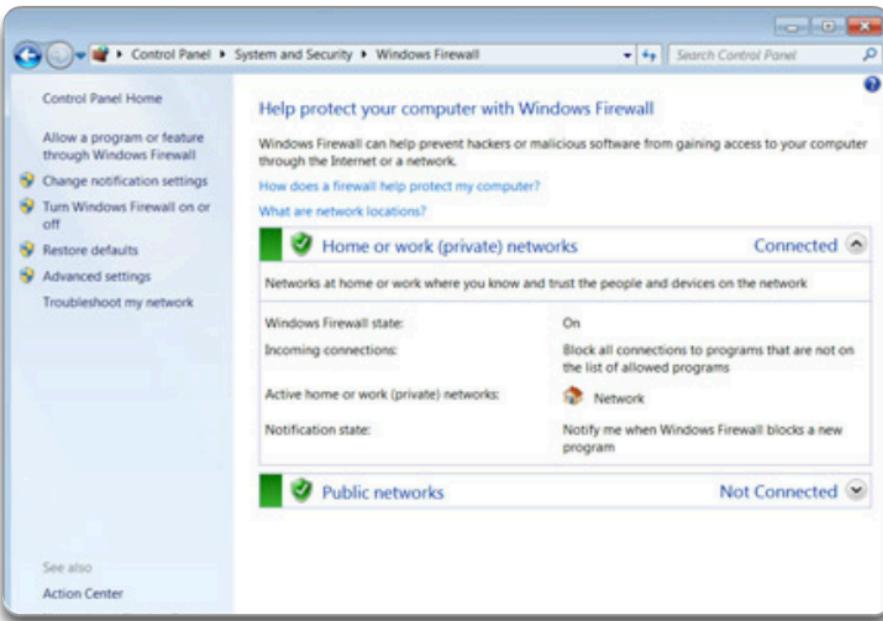
- **Window 7 Firewall** - Runs continuously to protect against unauthorized communications to and from your computer.

**Windows 7 Action Center**

**Antivirus Program**

**Antispyware Program**

**Windows 7 Firewall**



## Organizational Tools

### Reference Tools

A technician must document all repairs and computer problems. The documentation can then be used as a reference for future problems or for other technicians who may not have encountered the problem before. The documents can be paper-based, but electronic forms are preferred because they can be easily searched for specific problems.

It is important that a technician document all services and repairs. These documents need to be stored centrally and made available to all other technicians. The documentation can then be used as reference material for similar problems that are encountered in the future. Good customer service includes providing the customer with a detailed description of the problem and the solution.

The screenshot shows the Microsoft TechNet Support website. At the top, there's a navigation bar with links for TechNet, Products, Resources, Downloads, and Support. A search bar with the placeholder "Search TechNet with Bing" is positioned above the main content area. The main title is "TechNet Support". Below it, there are three numbered sections: 1. Search for a Solution, which includes fields for "Search all sources:" (with "Enter keywords" and a magnifying glass icon), "Lookup KB articles:" (with "Enter KB #" and a magnifying glass icon), and "Lookup Events & Errors:" (with "Enter ID or Code" and a magnifying glass icon). 2. Ask a Question in the Forums, which lists categories like Exchange Server, Forefront, Office 2007 Deployment, Office 2010, SharePoint Products, SQL Server, System Center, System Center Virtual Machine Manager, Windows 7, and Windows Server, each with a magnifying glass icon. 3. Contact Microsoft for Additional Help, which contains a link to "Use the links below to see assisted support options that are available from Microsoft".

## Personal Reference Tools

Personal reference tools include troubleshooting guides, manufacturer manuals, quick reference guides, and repair journals. In addition to an invoice, a technician keeps a journal of upgrades and repairs. The documentation in the journal includes descriptions of the problem, possible solutions that have been attempted, and the steps taken to repair the problem. Note any configuration changes made to the equipment and any replacement parts used in the repair. This documentation is valuable when you encounter similar situations in the future.

- **Notes** - Make notes as you go through the troubleshooting and repair process. Refer to these notes to avoid repeating previous steps and to determine what steps to take next.
- **Journal** - Document the upgrades and repairs that you perform. Include descriptions of the problem, possible solutions that have been tried to correct the problem, and the steps taken to repair the problem. Note any configuration changes made to the equipment and any replacement parts used in the repair. Your journal, along with your notes, can be valuable when you encounter similar situations in the future.

- **History of repairs** - Make a detailed list of problems and repairs, including the date, replacement parts, and customer information. The history allows a technician to determine what work has been performed on a specific computer in the past.

## Internet Reference Tools

The Internet is an excellent source of information about specific hardware problems and possible solutions:

- Internet search engines
- News groups
- Manufacturer FAQs
- Online computer manuals
- Online forums and chat
- Technical websites

The figure shows an example of a technical website.

## Miscellaneous Tools

With experience, you will discover many additional items to add to the toolkit. This image shows how a roll of masking tape can be used to label parts that have been removed from a computer when a parts organizer is not available.

A working computer is also a valuable resource to take with you on computer repairs in the field. A working computer can be used to research information, download tools or drivers, and communicate with other technicians.



The image below shows the types of computer replacement parts to include in a toolkit. Make sure that the parts are in good working order before you use them. Using known good components to replace possible bad ones in computers helps you quickly determine which component is not working properly.



Case Fan



Motherboard



CPU Fan



Power Supply



RAM



Hard Drive



NIC



Sound Adapter



Video Adapter



SSD

## **Demonstrate Proper Tool Use**

### **Antistatic Wrist Strap**

Safety in the workplace is everyone's responsibility. You are much less likely to injure yourself or damage components when using the proper tool for the job.

Before cleaning or repairing equipment, make sure that your tools are in good condition. Clean, repair, or replace items that are not functioning adequately.

An example of ESD is the small shock that you receive when you walk across a carpeted room and touch a doorknob. Although the small shock is harmless to you, the same electrical charge passing from you to a computer can damage its components. Self-grounding or wearing an antistatic wrist strap can prevent ESD damage to computer components.

The purpose of self-grounding or wearing an antistatic wrist strap is to equalize the electrical charge between you and the equipment. Self-grounding is done by touching a bare metal part of a computer case. The antistatic wrist strap is a conductor that connects your body to the equipment that you are working on. When static electricity builds up in your body, the connection made by the wrist strap to the equipment, or ground, channels the electricity through the wire that connects the strap.

As shown in the figure, the wrist strap has two parts and is easy to wear:

**Step 1.** Wrap the strap around your wrist and secure it using the snap or Velcro. The metal on the back of the wrist strap must remain in contact with your skin at all times.

**Step 2.** Snap the connector on the end of the wire to the wrist strap, and connect the other end either to the equipment or to the same grounding point that the antistatic mat is connected to. The metal skeleton of the case is a good place to connect the wire. When connecting the wire to equipment that you are working on, choose an unpainted metal surface. A painted surface does not conduct electricity as well as unpainted metal.

**NOTE:** Attach the wire on the same side of the equipment as the arm wearing the antistatic wrist strap. This helps keep the wire out of the way while you are working.

Although wearing a wrist strap helps prevent ESD, you can further reduce the risks by not wearing clothing made of silk, polyester, or wool. These fabrics are more likely to generate a static charge.

**NOTE:** Technicians should roll up their sleeves, remove scarves or ties, and tuck in shirts to prevent interference from clothing. Ensure that earrings, necklaces, and other loose jewelry are properly secured.

**CAUTION:** Never wear an antistatic wrist strap if you are repairing a CRT monitor or a power supply unit.

### **Antistatic Mat**

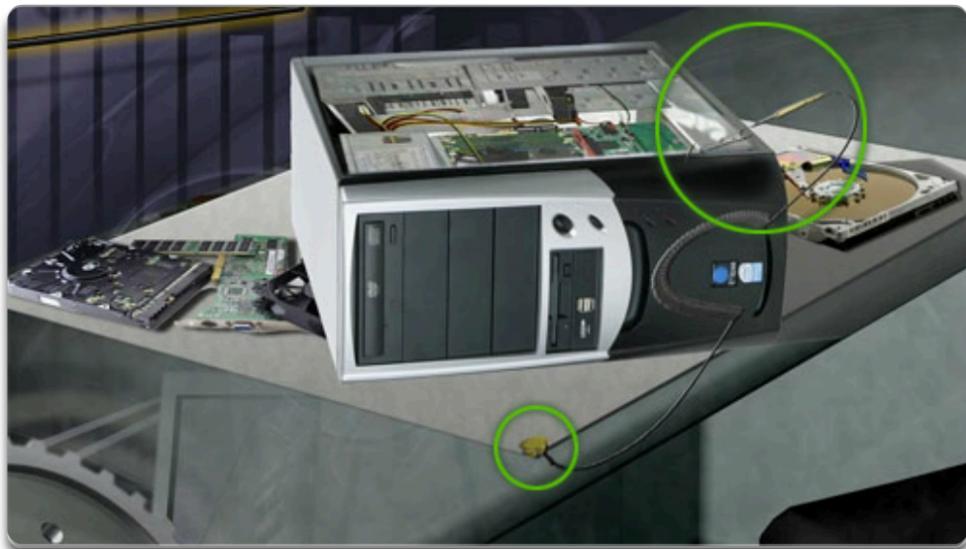
You may not always have the option to work on a computer in a properly equipped workspace. If you can control the environment, try to set up your workspace away from carpeted areas. Carpets can cause the buildup of electrostatic charges. If you cannot avoid the carpeting, ground yourself to the unpainted portion of the case of the computer on which you are working before touching any components.



An antistatic mat is slightly conductive. It works by drawing static electricity away from a component and transferring it safely from equipment to a grounding point, as shown in the figure:

**Step 1.** Lay the mat on the workspace next to or under the computer case.

**Step 2.** Clip the mat to the case to provide a grounded surface on which you can place parts as you remove them from the system.



When you are working at a workbench, ground the workbench and the antistatic floor mat. By standing on the mat and wearing the wrist strap, your body has the same charge as the equipment and reduces the probability of ESD.

Reducing the potential for ESD reduces the likelihood of damage to delicate circuits or components.

**NOTE:** Always handle components by the edges.

## Hand Tools

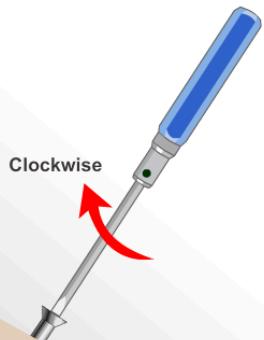
A technician needs to be able to properly use each tool in the toolkit. This page covers many of the various hand tools used when repairing computers.

### Screws

Match each screw with the proper screwdriver. Place the tip of the screwdriver on the head of the

#### Proper Screwdriver Use

screw. Turn the screwdriver clockwise to tighten the screw and counterclockwise to loosen the screw.



#### Proper Screwdriver Use



## Stripped Screw

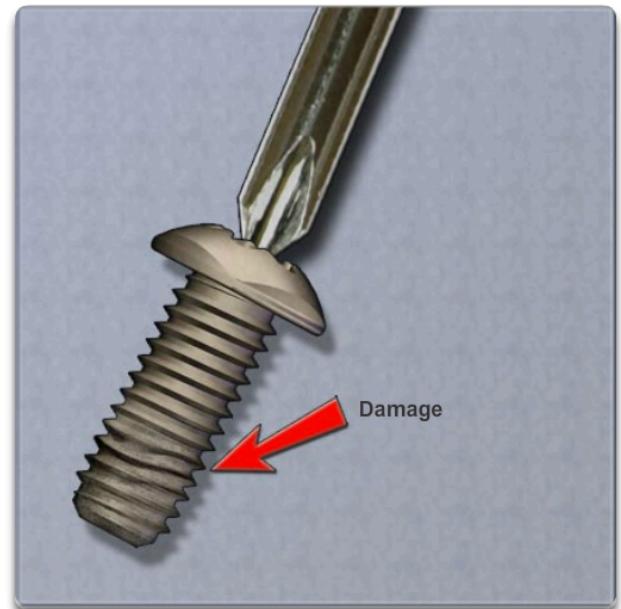
Screws can become stripped if you over-tighten them with a screwdriver. A stripped screw may get stuck in the screw hole, or it may not tighten firmly. Discard stripped screws.

## Flat Head Screwdriver

As shown in below, use a flat head screwdriver when you are working with a slotted screw. Do not use a flat head screwdriver to remove a Phillips head screw. Never use a

screwdriver as a pry bar. If you cannot remove a component, check to see if there is a clip or latch that is securing the component in place.

### Flat Head Screwdriver



**CAUTION:** If excessive force is needed to remove or add a component, something is probably wrong. Take a second look to make sure that you have not missed a screw or a locking clip that is holding the component in place. Refer to the device manual or diagram for additional information.

## Phillips Head Screwdriver

As shown below, use a Phillips head screwdriver with crosshead screws. Do not use this type of screwdriver to puncture anything. This will damage the head of the screwdriver.

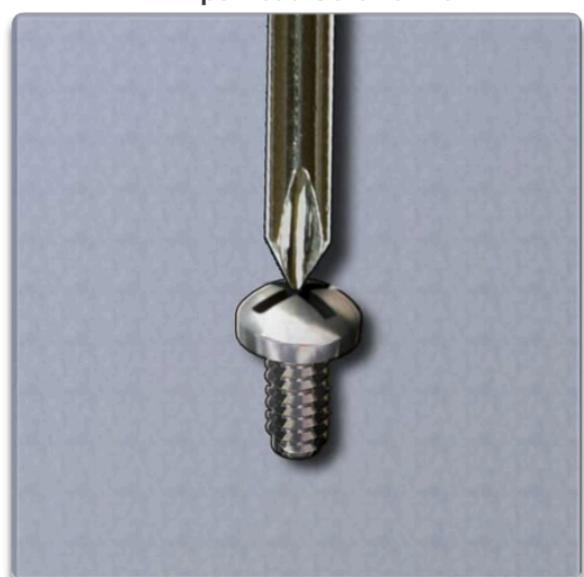
## Hex Driver

Use a hex driver to loosen and tighten bolts that have a hexagonal (six-sided) head. Hex bolts should not be over-tightened because the threads of the bolts can be stripped. Do not use a hex driver that is too large for the bolt that you are using.

### Hex Driver



## Phillips Head Screwdriver



**CAUTION:** Some tools are magnetized. When working around electronic devices, be sure that the tools you are using have not been magnetized. Magnetic fields can be

harmful to data stored on magnetic media. Test your tool by touching the tool with a screw. If the screw is attracted to the tool, do not use the tool.

## Component Retrieving Tools

Needle-nose pliers and tweezers can be used to place and retrieve parts that may be hard to reach with your fingers. There are also tools called part retrievers that are specifically designed for this task. Do not scratch or hit any components when using these tools.

**CAUTION:** Pencils should not be used inside the computer to change the setting of switches or to pry off jumpers. The pencil lead can act as a conductor and may damage the computer components.

A computer technician needs proper tools to work safely and prevent damage to the computer equipment. A technician uses many tools to diagnose and repair computer problems:

## Component Retrieving Tools



- Straight-head screwdriver, large and small
- Phillips-head screwdriver, large and small
- Tweezers or part retriever
- Needle-nosed pliers
- Wire cutters
- Chip extractor
- Hex wrench set
- Torx screwdriver
- Nut driver, large and small
- Three-claw component holder
- Wire Stripper
- Crimper
- Punch Down Tool

- Digital multimeter
- Wrap plugs
- Small mirror
- Small dust brush
- Soft, lint-free cloth
- Cable ties
- Scissors
- Small flashlight
- Electrical tape
- Pencil or pen
- Compressed air

Various specialty tools, such as Torx bits, antistatic bags and gloves, and integrated circuit pullers, can be used to repair and maintain computers. Always avoid magnetized tools, such as screwdrivers with magnetic heads, or tools that use extension magnets to retrieve small metal objects that are out of reach. Using magnetic tools can cause loss of data on hard drives and floppy disks. Magnetic tools can also induce current, which can damage internal computer components. Additionally, there are specialized testing devices used to diagnose computer and cable problems:

- **Multimeter** - A device that measures AC/DC voltage, electric current, and other cable and electrical characteristics, as shown in Figure 7.
- **Power supply tester** - A device that checks whether the computer power supply is working properly. A simple power supply tester might just have indicator lights, while more advanced



To explore the different functions of the multimeter, click the buttons, the dial, and the leads.

## Multimeter

### Fluke Networks 110 Multimeter

The Fluke Networks 110 Multimeter is an example of equipment used to test for voltage. To explore the different functions of the multimeter, click on the buttons and switch positions.

versions show the amount of voltage and amperage.

- **Cable tester** - A device that checks for wiring shorts or faults, such as wires connected to the wrong pin.
- **Loopback plug** - A device that connects to a computer, hub, switch, or router port to perform a diagnostic procedure called a loopback test. In a loopback test, a signal is transmitted through a circuit and then returned to the sending device to test the integrity of the data transmission.

## Cleaning Materials

Keeping computers clean inside and out is a vital part of a maintenance program. Dirt can cause problems with the physical operation of fans, buttons, and other mechanical components. The image below shows severe dust buildup on computer components. On electrical components, an excessive buildup of dust acts like an insulator and traps the heat. This insulation impairs the ability of heat sinks and cooling fans to keep components cool, causing chips and circuits to overheat and fail.

**NOTE:** When using compressed air to clean inside the computer, blow the air around the components with a minimum distance of 4 inches (10 cm) from the nozzle. Clean the power supply and the fan from the back of the case.

**CAUTION:** Before cleaning any device, turn it off and unplug the device from the power source.



## **Computer Cases and Monitors**

Clean computer cases and the outside of monitors with a mild cleaning solution on a damp, lint-free cloth. Mix one drop of dishwashing liquid with 4 oz (118 ml) of water to create the cleaning solution. If water drips inside the case, allow enough time for the liquid to dry before powering on the computer.

## **LCD Screens**

Do not use ammoniated glass cleaners or any other solution on an LCD screen, unless the cleaner is specifically designed for the purpose. Harsh chemicals damage the coating on the screen. There is no glass protecting these screens, so be gentle when cleaning them and do not press firmly on the screen.

## CRT Screens

To clean the screens of CRT monitors, dampen a soft, clean, lint-free cloth with distilled water and wipe the screen from top to bottom. Then use a soft, dry cloth to wipe the screen and remove streaking.

Clean dusty components with a can of compressed air. Compressed air does not cause electrostatic buildup on components. Make sure that you are in a well-ventilated area before blowing the dust out of the computer. A best practice is to wear a dust mask to make sure that you do not breathe in the dust particles.

Blow out the dust using short bursts from the can. Never tip the can or use the can upside down. Do not allow the fan blades to spin from the force of the compressed air. Hold the fan in place. Fan motors can be ruined from spinning when the motor is not turned on.

## Component Contacts

Clean the contacts on components with isopropyl alcohol. Do not use rubbing alcohol. Rubbing alcohol contains impurities that can damage contacts. Make sure that the contacts do not collect lint from the cloth or cotton swab. Before reinstallation, use compressed air to blow lint off the contacts.

## Keyboards

Clean a desktop keyboard with compressed air and then use a hand-held vacuum cleaner with a brush attachment to remove the loose dust.

**CAUTION:** Never use a standard vacuum cleaner inside a computer case. The plastic parts of the vacuum cleaner can build up static electricity and discharge to the components. Use only vacuums that are approved for electronic components.

## Mice

Use glass cleaner and a soft cloth to clean the outside of the mouse. Do not spray glass cleaner directly on the mouse. If cleaning a ball mouse, you can remove the ball and clean it with glass cleaner and a soft cloth. Wipe the rollers clean inside the mouse with the same cloth. Do not spray any liquids inside the mouse.

Computer case and outside of monitor	Mild cleaning solution and lint-free cloth
LCD Screen	LCD cleaning solution or distilled water and lint-free cloth
CRT Screen	Distilled water and lint-free cloth
Heat Sink	Compressed air
RAM	Isopropyl alcohol and lint-free swab
Keyboard	Hand-held vacuum cleaner with a brush attachment
Mouse	Mild cleaning solution and lint-free cloth

The chart shows the computer items that you should clean and the cleaning materials to use.

## Summary

This chapter discussed safe lab procedures, correct tool usage, and the proper disposal of computer components and supplies. You have familiarized yourself in the lab with many of the tools used to build, service, and clean computer and electronic components. You have also learned the importance of organizational tools and how these tools help you work more efficiently.



Some of the important concepts to remember from this chapter:

- Work in a safe manner to protect users and equipment.
- Follow all safety guidelines to prevent injuries to yourself and others.
- Know how to protect equipment from ESD damage.
- Know about and be able to prevent power issues that can cause equipment damage or data loss.
- Know which products and supplies require special disposal procedures.
- Familiarize yourself with the MSDS for safety issues and disposal restrictions to help protect the environment.
- Be able to use the correct tools for the task.
- Know how to clean components safely.
- Use organizational tools during computer repairs.