Chapter 10

Installing and Configuring Printers

THE FOLLOWING COMPTIA A+ 220-801 EXAM OBJECTIVES ARE COVERED IN THIS CHAPTER:

✓ **4.1 Explain the differences between the various printer types and summarize the associated imaging process.**

- Laser
  - Imaging drum, fuser assembly, transfer belt, transfer roller, pickup rollers, separate pads, duplexing assembly
  - Imaging process: processing, charging, exposing, developing, transferring, fusing and cleaning
- Inkjet
  - Ink cartridge, print head, roller, feeder, duplexing assembly, carriage and belt
  - Calibration
- Thermal
  - Feed assembly, heating element
  - Special thermal paper
- Impact
  - Print head, ribbon, tractor feed
  - Impact paper

✓ **4.2 Given a scenario, install and configure printers.**

- Use appropriate printer drivers for a given operating system
- Print device sharing
  - Wired: USB, Parallel, Serial, Ethernet
  - Wireless: Bluetooth, 802.11x, Infrared (IR)
  - Printer hardware print server

- Printer sharing:
  - Sharing local/networked printer via Operating System settings

✓ **4.3 Given a scenario, perform printer maintenance.**

- Laser:
  - Replacing toner, applying maintenance kit, calibration, cleaning
- Thermal:
  - Replace paper, clean heating element, remove debris
- Impact:
  - Replace ribbon, replace print head, replace paper

Let's face it. No matter how much we try to get away from it, our society is dependent on paper. When we conduct business, we use different types of paper documents, such as contracts, letters, and, of course, money. And because most of those documents are created on computers, printers are inherently important. Even with electronic business being the norm in many situations, you will likely still have daily situations that require an old-fashioned hard copy of something.

Printers are electromechanical output devices that are used to put information from the computer onto paper. They have been around since the introduction of the computer. Other than the display monitor, the printer is the most popular peripheral purchased for a computer because a lot of people want to have paper copies of the documents they create.

In this chapter, we will discuss the details of each major type of printer, including impact printers, inkjet printers, laser printers, and thermal printers. Once we cover the different types, we'll talk about installing and configuring printers and finish up with a section on printer maintenance.

Take special note of the section on laser printers. The A+ exams test these subjects in detail, so we'll cover them in depth.

Printer troubleshooting is an objective of the 220-802 exam and consequently is covered in Chapter 20, "Hardware Troubleshooting."

Understanding Printer Types and Processes

Several types of printers are available on the market today. As with all other computer components, there have been significant advancements in printer technology over the years. Most of the time when faced with the decision of purchasing a printer, you're going to be weighing performance versus cost. Some of the higher-quality technologies, such as color laser printing, are rather expensive for the home user. Other technologies are less expensive but don't provide the same level of quality.

In the following sections, you will learn about the various types of printers that you will see as a technician as well as their basic components and how they function. Specifically, we are going to look at four classifications of printers: impact, inkjet (bubble-jet), laser, and thermal.

Impact Printers

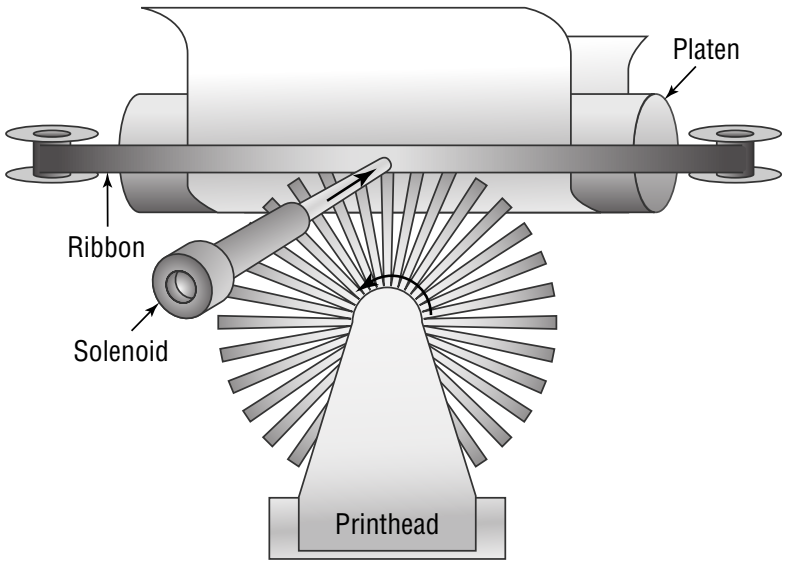
The most basic type of printer is in the category known as *impact printers*. Impact printers, as their name suggests, use some form of impact and an inked *ribbon* to make an imprint on the paper. Impact printers also use a paper feed mechanism called a *tractor feed* that requires special paper. Doubtless you've seen it before—it's continuous feed paper with holes running down both edges. In a manner of speaking, typewriters are like impact printers. Both use an inked ribbon and an impact head to make letters on the paper. The major difference is that the printer can accept input from a computer.

There are two major types of impact printers: daisy wheel and dot matrix. Each type has its own service and maintenance issues.

Daisy-Wheel Printers

The first type of impact printer we're going to discuss is the *daisy-wheel printer*. This is one of the oldest printing technologies in use. These impact printers contain a wheel (called the daisy wheel because it looks like a daisy) with raised letters and symbols on each "petal" (see Figure 10.1). When the printer needs to print a character, it sends a signal to the mechanism that contains the wheel. This mechanism is called the *print head*. The print head rotates the daisy wheel until the required character is in place. An electromechanical hammer (called a *solenoid*) then strikes the back of the petal containing the character. The character pushes up against an inked ribbon that ultimately strikes the paper, making the impression of the requested character.

FIGURE 10.1 A daisy-wheel printer mechanism



You may see the term *print head* written as one word: *printhead*. There doesn't seem to be a specific convention one way or the other, so know that either way is fine.

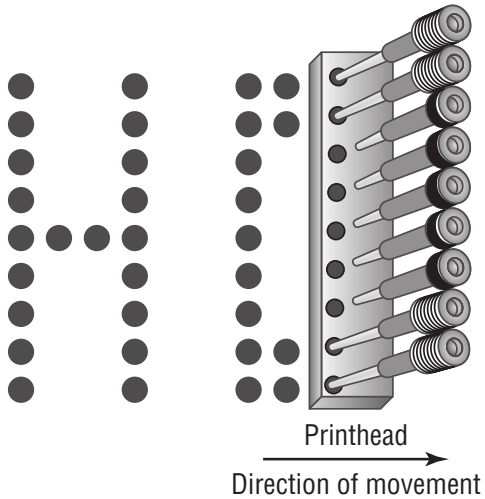
Daisy-wheel printers were among the first types of impact printer developed. Their speed is rated by the number of *characters per second (cps)* they can print. The earliest printers could print only two to four characters per second. Aside from their poor speed, the main disadvantage to this type of printer is that it makes a lot of noise when printing—so much, in fact, that special enclosures were developed to contain the noise.

The daisy-wheel printer has a few advantages, of course. First, because it is an impact printer, you can print on multipart forms (like carbonless receipts), assuming they can be fed into the printer properly. Sometimes you will hear this type of paper referred to as *impact paper*. Second, it is relatively inexpensive compared to the price of a laser printer of the same vintage. Finally, the print quality is comparable to that of a typewriter because it uses a very similar technology. This typewriter level of quality was given a name: *letter quality (LQ)*. Today, LQ might refer to quality that's better than a typewriter but not up to inkjet standards.

Dot-Matrix Printers

The other type of impact printer we'll discuss is the *dot-matrix printer*. These printers work in a manner similar to daisy-wheel printers, but instead of a spinning, character-imprinted wheel, the print head contains a row of pins (short, sturdy stalks of hard wire). These pins are triggered in patterns that form letters and numbers as the print head moves across the paper (see Figure 10.2).

FIGURE 10.2 Formation of images in a dot-matrix printer



The pins in the print head are wrapped with coils of wire to create a solenoid and are held in the rest position by a combination of a small magnet and a spring. To trigger a particular pin, the printer controller sends a signal to the print head, which energizes the wires around

the appropriate print wire. This turns the print wire into an electromagnet, which repels the print pin, forcing it against the ink ribbon and making a dot on the paper. The arrangement of the dots in columns and rows creates the letters and numbers you see on the page. Figure 10.2 shows this process.

The main disadvantage of dot-matrix printers is their image quality, which can be quite poor compared to the quality produced with a daisy wheel. Dot-matrix printers use patterns of dots to make letters and images, and the early dot-matrix printers used only nine pins to make those patterns. The output quality of such printers is referred to as *draft quality*—good mainly for providing your initial text to a correspondent or reviser. Each letter looked fuzzy because the dots were spaced as far as they could be and still be perceived as a letter or image. As more pins were crammed into the print head (17-pin and 24-pin models were eventually developed), the quality increased because the dots were closer together. Dot-matrix technology ultimately improved to the point that a letter printed on a dot-matrix printer was *almost* indistinguishable from typewriter output. This level of quality is known as *near letter quality (NLQ)*.

Dot-matrix printers are noisy, but the print wires and print head are covered by a plastic dust cover, making them quieter than daisy-wheel printers. They also use a more efficient printing technology, so the print speed is faster (typically starting around 72cps). Some dot-matrix printers (like the Epson DFX series) can print at close to a page per second! Finally, because dot-matrix printers are also impact printers, they can use multipart forms. Because of these advantages, dot-matrix printers quickly made daisy-wheel printers obsolete.

Most impact printers have an option to adjust how close the print head rests from the ribbon. So if your printing is too light, you may be able to adjust the print head closer to the ribbon. If it's too dark or you get smeared printing, you may be able to move the print head back.

Inkjet (Bubble-Jet)

One of the most popular types of printers in use today are *inkjet printers*. You might also hear these types of printers referred to as bubble-jet printers, but that term is copyrighted by Canon. As opposed to impact printers, which strike the page, these printers spray ink on the page to form the image. Older inkjet printers used a reservoir of ink, a pump, and a nozzle to accomplish this. They were messy, noisy, and inefficient. Bubble-jet printers work much more efficiently and are much cheaper. For purposes of the exam, consider them one in the same because their components and printing processes are nearly identical.

The main difference is that in a *bubble-jet printer*, droplets of ink are sprayed onto a page and form patterns that resemble the items being printed. You can think of it as spraying droplets of ink in a very high-definition dot-matrix pattern, although printer manufacturers would likely scoff at the comparison to an older technology. In the following sections, you will learn the parts of a bubble-jet printer as well as how bubble-jet printers work.

Parts of a Typical Bubble-Jet Printer

Bubble-jet printers are simple devices. They contain very few parts (even fewer than dot-matrix printers) and, as such, are inexpensive to manufacture. It's common today to have a $40 to $50 bubble-jet printer with print quality that rivals that of basic laser printers.

The printer parts can be divided into the following categories:

- Print head/ink cartridge
- Head carriage, belt, and stepper motor
- Paper-feed mechanism
- Control, interface, and power circuitry

Print Head/Ink Cartridge

The first part of a bubble-jet printer is the one people see the most: the *print head*. This part of a printer contains many small nozzles (usually 100 to 200) that spray the ink in small droplets onto the page. Many times the print head is part of the *ink cartridge*, which contains a reservoir of ink and the print head in a removable package. Most color bubble-jet printers include multiple print heads, one for each of the *CMYK (cyan, magenta, yellow, and black)* print inks. The print cartridge must be replaced as the ink supply runs out.

Inside the ink cartridge are several small chambers. At the top of each chamber are a metal plate and a tube leading to the ink supply. At the bottom of each chamber is a small pinhole. These pinholes are used to spray ink on the page to form characters and images as patterns of dots, similar to the way a dot-matrix printer works but with much higher resolution.

There are two methods of spraying the ink out of the cartridge. The first was popularized by Hewlett-Packard (HP): When a particular chamber needs to spray ink, an electric signal is sent to the heating element, energizing it. The elements heat up quickly, causing the ink to vaporize. Because of the expanding ink vapor, the ink is pushed out the pinhole and forms a bubble. As the vapor expands, the bubble eventually gets large enough to break off into a droplet. The rest of the ink is pulled back into the chamber by the surface tension of the ink. When another drop needs to be sprayed, the process begins again. The second method, developed by Epson, uses a piezoelectric element (either a small rod or a unit that looks like a miniature drum head) that flexes when energized. The outward flex pushes the ink from the nozzle; on the return, it sucks more ink from the reservoir.

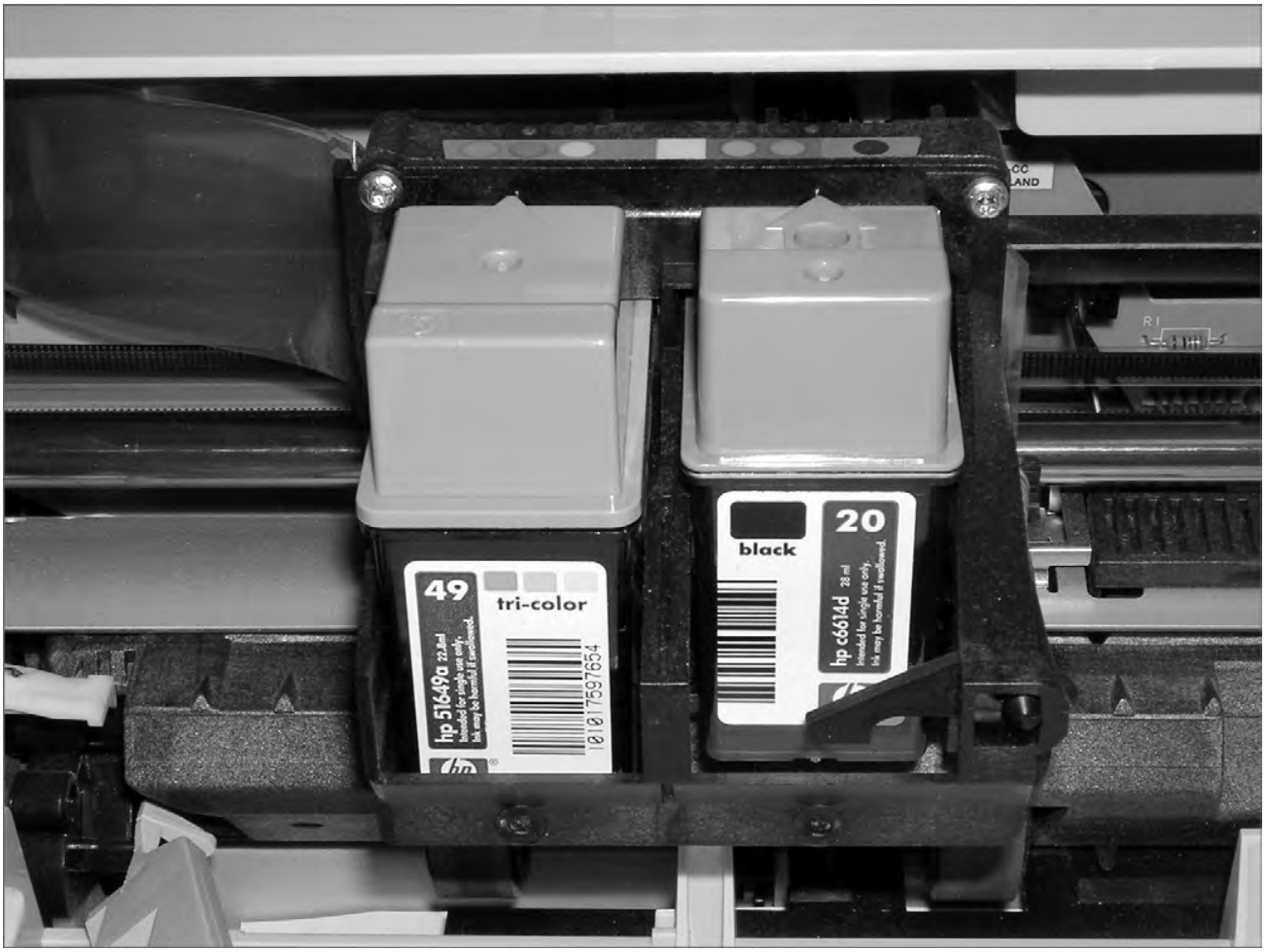
When the printer is done printing, the print head moves back to its maintenance station. The *maintenance station* contains a small suction pump and ink-absorbing pad. To keep the ink flowing freely, before each print cycle the maintenance station pulls ink through the ink nozzles using vacuum suction. This expelled ink is absorbed by the pad. The station serves two functions: to provide a place for the print head to rest when the printer isn't printing and to keep the print head in working order.

Head Carriage, Belt, and Stepper Motor

Another major component of the bubble-jet printer is the head carriage and the associated parts that make it move. The *print head carriage* is the component of a bubble-jet printer

that moves back and forth during printing. It contains the physical as well as electronic connections for the print head and (in some cases) the ink reservoir. Figure 10.3 shows an example of a head carriage. Note the clips that keep the ink cartridge in place and the electronic connections for the ink cartridge. These connections cause the nozzles to fire, and if they aren't kept clean, you may have printing problems.

FIGURE 10.3 A print head carriage (holding two ink cartridges) in a bubble-jet printer

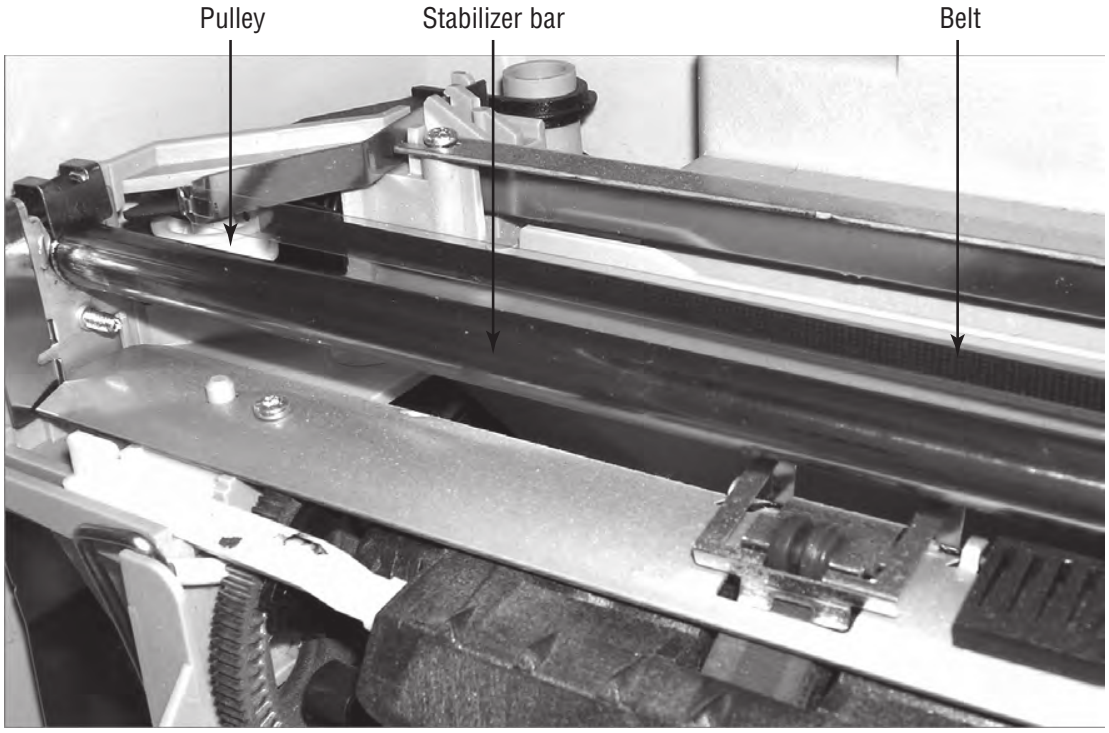


The stepper motor and belt make the print head carriage move. A *stepper motor* is a precisely made electric motor that can move in the same very small increments each time it is activated. That way, it can move to the same position(s) time after time. The motor that makes the print head carriage move is also often called the *carriage motor* or *carriage stepper motor*. Figure 10.4 shows an example of a stepper motor.

In addition to the motor, a belt is placed around two small wheels or pulleys and attached to the print head carriage. This belt, called the *carriage belt*, is driven by the carriage motor and moves the print head back and forth across the page while it prints. To keep the print head carriage aligned and stable while it traverses the page, the carriage rests on a small metal *stabilizer bar*. Figure 10.5 shows the stabilizer bar, carriage belt, and pulleys.

FIGURE 10.4 A carriage stepper motor

FIGURE 10.5 Stabilizer bar, carriage belt, and pulleys in a bubble-jet printer



Paper-Feed Mechanism

In addition to getting the ink onto the paper, the printer must have a way to get the paper into the printer. That's where the paper-feed mechanism comes in. The *paper-feed mechanism* picks up paper from the paper drawer and feeds it into the printer. This component consists of several smaller assemblies. First are the *pickup rollers* (Figure 10.6), which are several rubber rollers with a slightly flat spot; they rub against the paper as they rotate, and feed the paper into the printer. They work against small cork or rubber patches known as *separator pads* (Figure 10.7), which help keep the rest of the paper in place so that only one sheet goes into the printer. The pickup rollers are turned on a shaft by the *pickup stepper motor.*

FIGURE 10.6 Bubble-jet pickup rollers

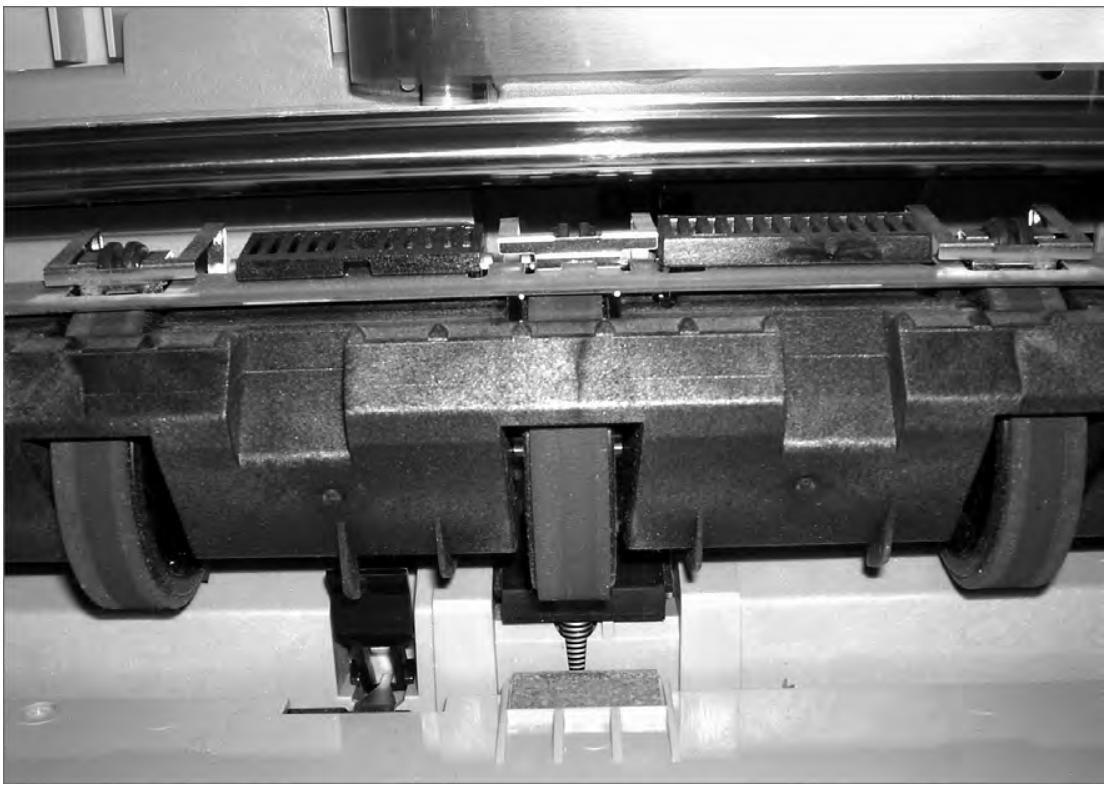
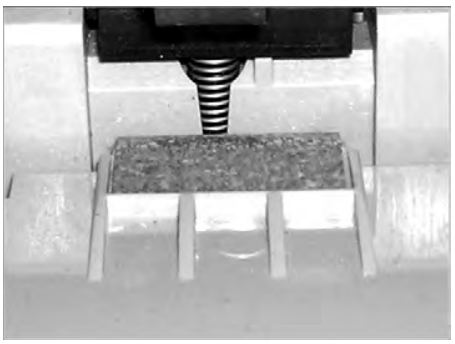


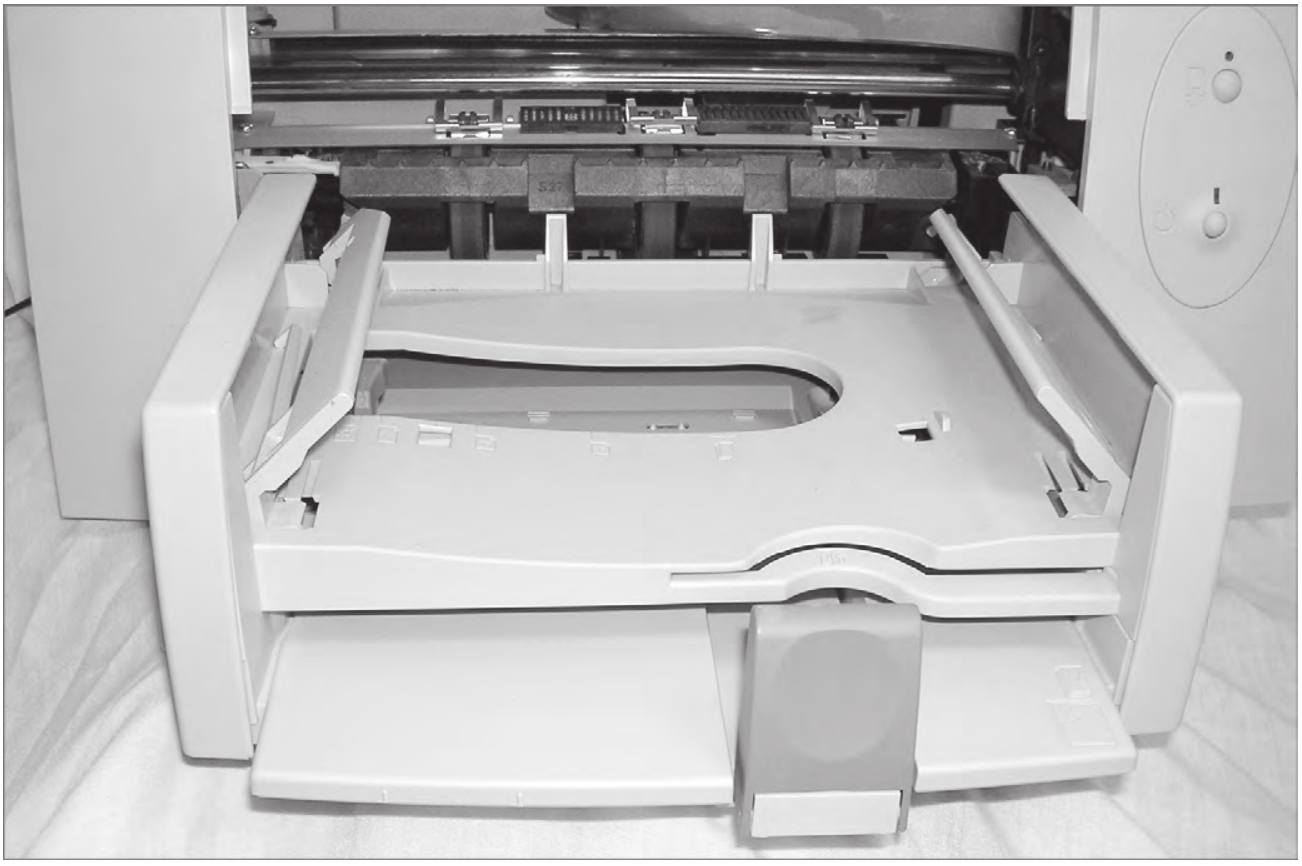
FIGURE 10.7 Bubble-jet separator pads



Clean pickup rollers (and other rubber rollers) with mild soap and water and not alcohol. Alcohol can dry out the rollers, making them brittle and ineffective.

Sometimes the paper that is fed into a bubble-jet printer is placed into a *paper tray*, which is simply a small plastic tray in the front of the printer that holds the paper until it is fed into the printer by the paper-feed mechanism. On smaller printers, the paper is placed vertically into a *paper feeder* at the back of the printer; it uses gravity, in combination with feed rollers and separator pads, to get the paper into the printer. No real rhyme or reason dictates which manufacturers use these different parts; some models use them, and some don't. Generally, more expensive printers use paper trays because they hold more paper. Figure 10.8 shows an example of a paper tray on a bubble-jet printer.

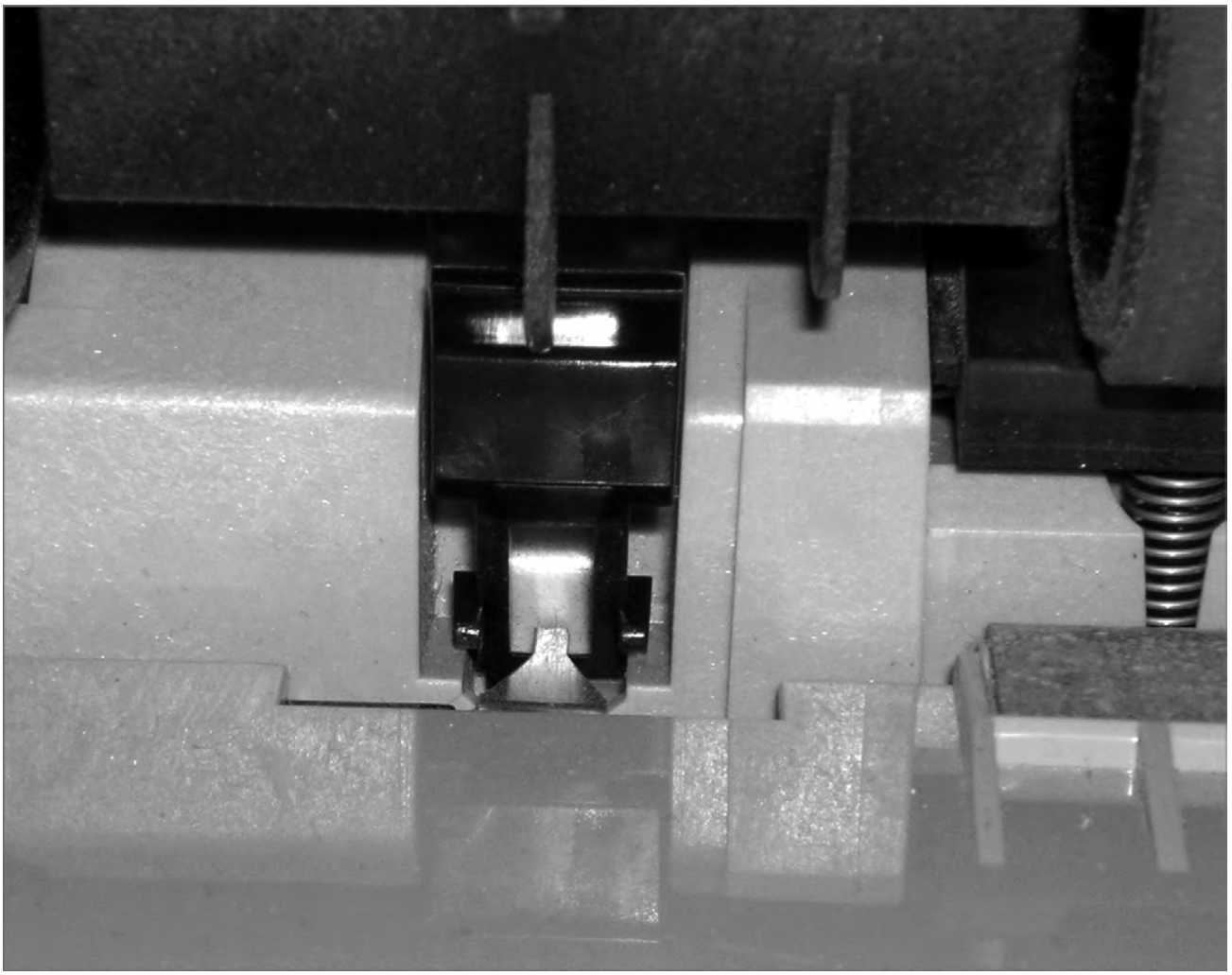
FIGURE 10.8 A paper tray on a bubble-jet printer



The final parts of the paper-feed mechanism are the *paper-feed sensors*. These components tell the printer when it is out of paper as well as when a paper jam has occurred during the paper-feed process. Figure 10.9 shows an example of a paper-feed sensor.

Being able to identify the parts of a bubble-jet printer is an important skill for an A+ candidate. In Exercise 10.1 you will identify the parts of a bubble-jet printer. For this exercise, you'll need a bubble-jet printer.

FIGURE 10.9 A paper-feed sensor on a bubble-jet printer



EXERCISE 10.1

Identifying the Parts of a Bubble-jet Printer

1. Unplug the bubble-jet printer from the power source and the computer.
2. Open the top cover to expose the inner print mechanism.
3. Locate and identify the paper tray.
4. Locate and identify the paper-feed sensor.
5. Locate and identify the pickup roller(s).
6. Locate and identify the separator pad(s).
7. Locate and identify the print head and carriage assembly.

Control, Interface, and Power Circuitry

The final component group is the electronic circuitry for printer control, printer interfaces, and printer power. The *printer control circuits* are usually on a small circuit board that contains all the circuitry to run the stepper motors the way the printer needs them to work (back and forth, load paper and then stop, and so on). These circuits are also responsible for monitoring the health of the printer and reporting that information back to the PC.

The second power component, the interface circuitry (commonly called a port), makes the physical connection to whatever signal is coming from the computer (parallel, serial, network, infrared, and so on) and also connects the physical interface to the control circuitry. The interface circuitry converts the signals from the interface into the datastream that the printer uses.

The last set of circuits the printer uses is the *power circuits*. Essentially, these conductive pathways convert 110V (in the United States) or 220V (in most of the rest of the world) from a standard wall outlet into the voltages the bubble-jet printer uses, usually 12V and 5V, and distribute those voltages to the other printer circuits and devices that need it. This is accomplished through the use of a *transformer*. A transformer, in this case, takes the 110V AC current and changes it to 12V DC (among others). This transformer can be either internal (incorporated into the body of the printer) or external. Either design can be used in today's bubble-jets, although the integrated design is preferred because it is simpler and doesn't show the bulky transformer.

The Bubble-Jet Printing Process

Just as with other types of printing, the bubble-jet printing process consists of a set of steps the printer must follow in order to put the data onto the page being printed. The following steps take place whenever you click the Print button in your favorite software (like Microsoft Word or Internet Explorer):

1. You click the Print button (or similar) that initiates the printing process.
2. The software you are printing from sends the data to be printed to the printer driver you have selected.

The function and use of the printer driver are discussed later in this chapter.

3. The printer driver uses a page-description language to convert the data being printed into the format that the printer can understand. The driver also ensures that the printer is ready to print.
4. The printer driver sends the information to the printer via whatever connection method is being used (USB, network, parallel, and so on).
5. The printer stores the received data in its onboard *print buffer* memory. A print buffer is a small amount of memory (typically 512KB to 16MB) used to store print jobs as they are received from the printing computer. This buffer allows several jobs to be printed at once and helps printing to be completed quickly.

6. If the printer has not printed in a while, the printer's control circuits activate a cleaning cycle. A *cleaning cycle* is a set of steps the bubble-jet printer goes through to purge the print heads of any dried ink. It uses a special suction cup and sucking action to pull ink through the print head, dislodging any dried ink or clearing stuck passageways.
7. Once the printer is ready to print, the control circuitry activates the paper-feed motor. This causes a sheet of paper to be fed into the printer until the paper activates the paper-feed sensor, which stops the feed until the print head is in the right position and the leading edge of the paper is under the print head. If the paper doesn't reach the paper-feed sensor in a specified amount of time after the stepper motor has been activated, the Out Of Paper light is turned on and a message is sent to the computer.
8. Once the paper is positioned properly, the print head stepper motor uses the print head belt and carriage to move the print head across the page, little by little. The motor is moved one small step, and the print head sprays the dots of ink on the paper in the pattern dictated by the control circuitry. Typically, this is either a pattern of black dots or a pattern of CMYK inks that are mixed to make colors. Then the stepper motor moves the print head another small step; the process repeats all the way across the page. This process is so quick, however, that the entire series of starts and stops across the page looks like one smooth motion.
9. At the end of a pass across the page, the paper-feed stepper motor advances the page a small amount. Then the print head repeats step 8. Depending on the model, either the print head returns to the beginning of the line and prints again in the same direction only or it moves backward across the page so that printing occurs in both directions. This process continues until the page is finished.
10. Once the page is finished, the feed-stepper motor is actuated and ejects the page from the printer into the output tray. If more pages need to print, the process for printing the next page begins again at step 7.
11. Once printing is complete and the final page has been ejected from the printer, the print head is *parked* (locked into rest position) and the print process is finished.

Some nicer models of bubble-jet printers will have a *duplexing assembly* attached to them, usually at the back of the printer. It's used for two-sided printing. After the first page is printed, it's fed into the duplexing assembly, turned over, and fed back into the paper feed assembly. Then the second page can be printed on the back side of the original piece of paper. It's a fancy attachment that gives your bubble-jet more functionality.

Laser Printers

Laser printers and inkjet printers are referred to as *page printers* because they receive their print job instructions one page at a time rather than receiving instructions one line at a time. There are two major types of page printers that use the electrophotographic (EP) print process. The first uses a laser to scan the image onto a photosensitive drum, and the second uses an array of light-emitting diodes (LEDs) to create the image on the drum. Even though they write the image in different ways, both types still follow the EP print process. Since the A+ exam

focuses on the EP print process and not on differences between laser and LED, we'll focus on the same here.

Xerox, Hewlett-Packard, and Canon were pioneers in developing the laser printer technology we use today. Scientists at Xerox developed the electrophotographic (EP) process in 1971. The first successful desktop laser printer was introduced by HP in 1984 using Canon hardware that used the EP process. This technology uses a combination of static electric charges, laser light, and a black powdery ink-like substance called *toner*. Printers that use this technology are called EP process laser printers, or just *laser printers*. Every laser printer technology has its foundations in the EP printer process.

Let's discuss the basic components of the EP laser printer and how they operate so you can understand the way an EP laser printer works.

Basic Components

Most printers that use the EP process contain nine standard assemblies: the toner cartridge, laser scanner, high-voltage power supply, DC power supply, paper transport assembly (including paper-pickup rollers and paper-registration rollers), transfer corona, fusing assembly, printer controller circuitry, and ozone filter. Let's discuss each of the components individually before we examine how they all work together to make the printer function.

The Toner Cartridge

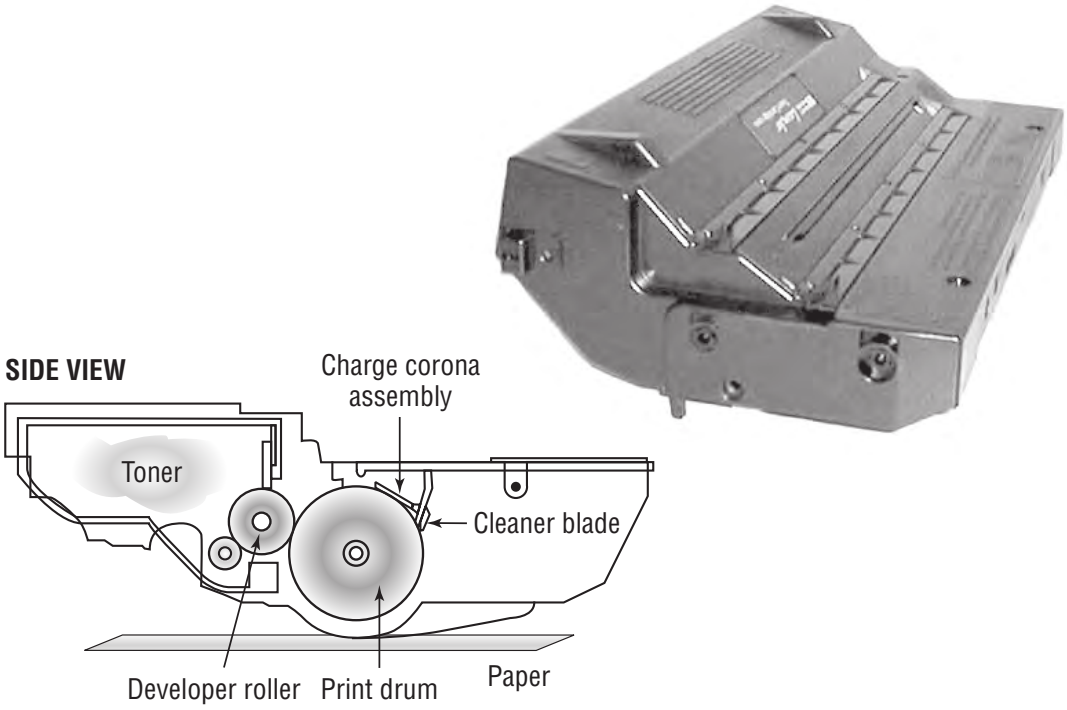
The EP toner cartridge (Figure 10.10), as its name suggests, holds the toner. Toner is a black carbon substance mixed with polyester resins to make it flow better and iron oxide particles to make it sensitive to electrical charges. These two components make the toner capable of being attracted to the photosensitive drum and of melting into the paper. In addition to these components, toner contains a medium called the developer (also called the carrier), which carries the toner until it is used by the EP process. The toner cartridge also contains the EP print drum. This drum is coated with a photosensitive material that can hold a static charge when not exposed to light but *cannot* hold a charge when it *is* exposed to light—a curious phenomenon and one that EP printers exploit for the purpose of making images. Finally, the drum assembly contains a cleaning blade that continuously scrapes the used toner off the photosensitive drum to keep it clean.

Exposing a photosensitive drum to dust or light can damage it, but touching it will most likely render the drum inoperable! It's best to just not mess around with them.

In most laser printers, *toner cartridge* means an EP toner cartridge that contains toner and a photosensitive drum in one plastic case. In some laser printers, however, the toner and photosensitive drum can be replaced separately instead of as a single unit. If you ask for a toner cartridge for one of these printers, all you will receive is a cylinder full of toner. Consult the printer's manual to find out which kind of toner cartridge your laser printer uses.

Never ship a printer anywhere with a toner cartridge installed! If the printer is a laser printer, remove the toner cartridge first. If it's an LED page printer, there is a method to remove the photosensitive drum and toner hopper (check your manual for details).

FIGURE 10.10 An EP toner cartridge



The Laser Scanning Assembly

As we mentioned earlier, the EP photosensitive drum can hold a charge if it's not exposed to light. It is dark inside an EP printer, except when the laser scanning assembly shines on particular areas of the photosensitive drum. When it does that, the drum discharges, but only in the area that has been exposed. As the drum rotates, the laser scanning assembly scans the laser across the photosensitive drum, writing the image onto it. Figure 10.11 shows the laser scanning assembly.

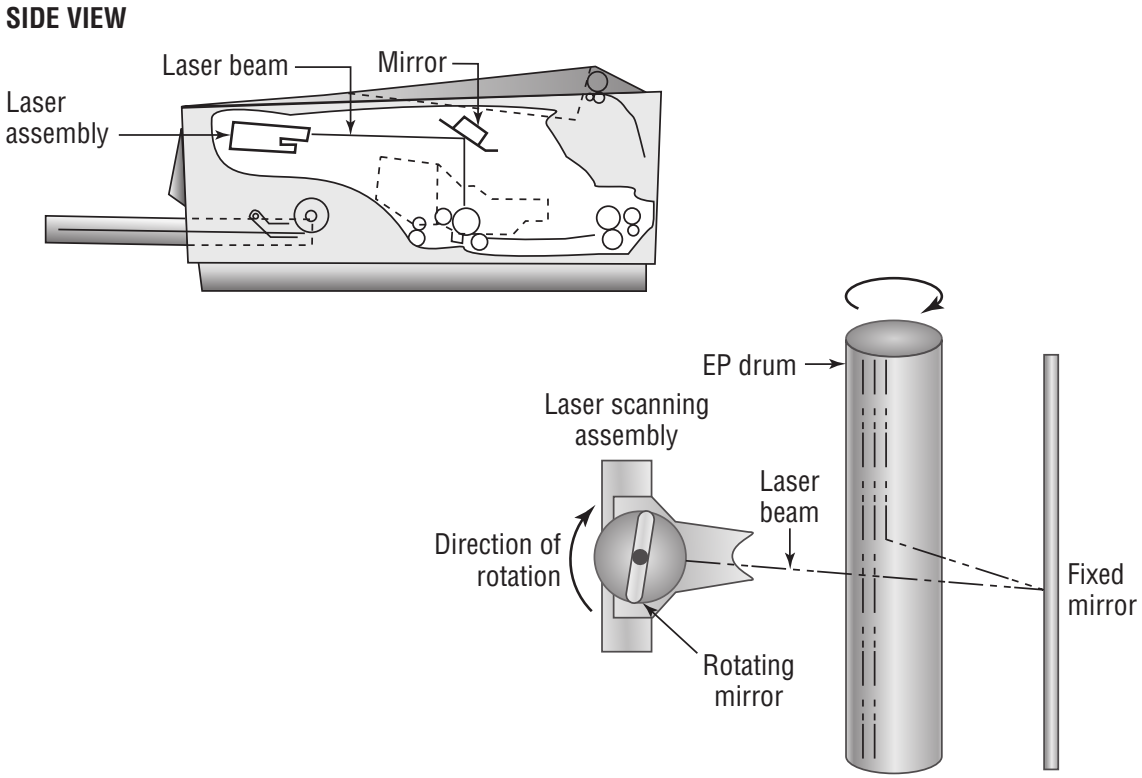
Laser light is damaging to human eyes. Therefore, the laser is kept in an enclosure and will operate only when the laser printer's cover is closed.

High-Voltage Power Supply (HVPS)

The EP process requires high-voltage electricity. The high-voltage power supply (HVPS) provides the high voltages used during the EP process. This component converts AC current from a standard wall outlet (120V and 60Hz) into higher voltages that the printer can use. This high voltage is used to energize both the charging corona and the transfer corona.

Anything with the words *high voltage* in it should make you pause before opening a device and getting your hands into it. The HVPS can hurt or kill you if you're inside a laser printer and don't know what you're doing.

FIGURE 10.11 The EP laser scanning assembly (side view and simplified top view)



DC Power Supply (DCPS)

The high voltages used in the EP process can't power the other components in the printer (the logic circuitry and motors). These components require low voltages, between +5 VDC and +24VDC. The DC power supply (DCPS) converts house current into three voltages: +5VDC and –5VDC for the logic circuitry and +24VDC for the paper-transport motors. This component also runs the fan that cools the internal components of the printer.

Paper-Transport Assembly

The paper-transport assembly is responsible for moving the paper through the printer. It consists of a motor and several rubberized rollers that each performs a different function.

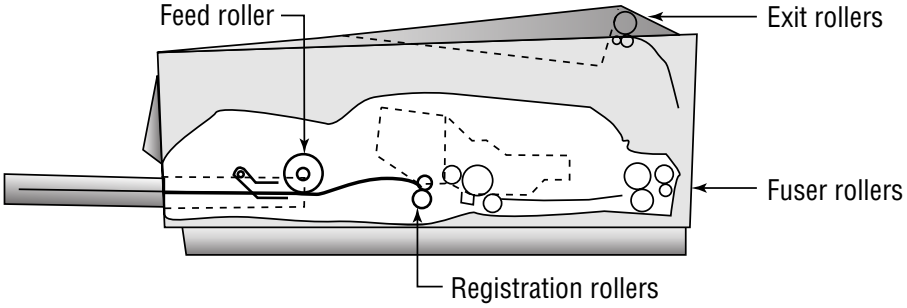
The first type of roller found in most laser printers is the *feed roller*, or *paper-pickup roller* (Figure 10.12). This D-shaped roller, when activated, rotates against the paper and pushes one sheet into the printer. This roller works in conjunction with a special rubber separator pad to prevent more than one sheet from being fed into the printer at a time.

Another type of roller that is used in the printer is the *registration roller* (also shown in Figure 10.12). There are actually two registration rollers, which work together. These rollers

synchronize the paper movement with the image-formation process in the EP cartridge. The rollers don't feed the paper past the EP cartridge until the cartridge is ready for it.

Both of these rollers are operated with a special electric motor known as an *electronic stepper motor*. This type of motor can accurately move in very small increments. It powers all the paper-transport rollers as well as the fuser rollers.

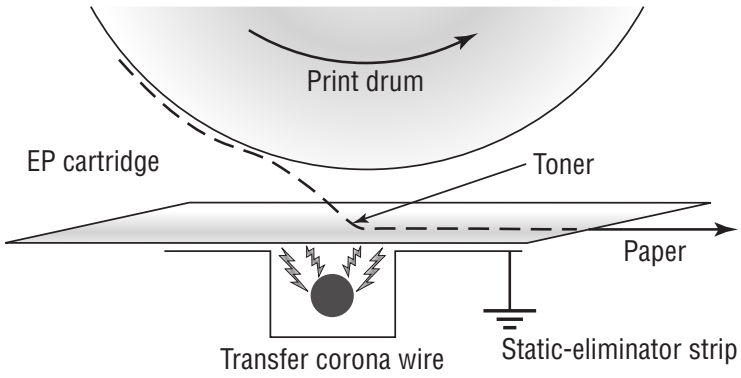
FIGURE 10.12 Paper-transport rollers



The Transfer Corona Assembly

When the laser writes the images on the photosensitive drum, the toner then sticks to the exposed areas; we'll cover this in the next section, "Electrophotographic (EP) Print Process." How does the toner get from the photosensitive drum onto the paper? The *transfer corona assembly* (Figure 10.13) is given a high-voltage charge, which is transferred to the paper, which in turn pulls the toner from the photosensitive drum.

FIGURE 10.13 The transfer corona assembly



Included in the transfer corona assembly is a *static-charge eliminator strip* that drains away the charge imparted to the paper by the corona. If you didn't drain away the charge, the paper would stick to the EP cartridge and jam the printer.

There are two types of transfer corona assemblies: those that contain a transfer *corona wire* and those that contain a transfer *corona roller*. The transfer corona wire is a small-diameter wire that is charged by the HVPS. The wire is located in a special notch in the floor of the laser printer (under the EP print cartridge). The transfer corona roller performs the same function as the transfer corona wire, but it's a roller rather

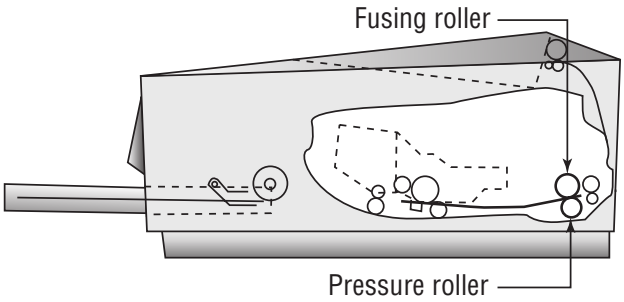
than a wire. Because the transfer corona roller is directly in contact with the paper, it supports higher speeds. For this reason, the transfer corona wire is infrequently used in laser printers today.

Fusing Assembly

The toner in the EP toner cartridge will stick to just about anything, including paper. This is true because the toner has a negative static charge and most objects have a net positive charge. However, these toner particles can be removed by brushing any object across the page. This could be a problem if you want the images and letters to stay on the paper permanently!

To solve this problem, EP laser printers incorporate a device known as a *fuser* (Figure 10.14), which uses two rollers that apply pressure and heat to fuse the plastic toner particles to the paper. You may have noticed that pages from either a laser printer or a copier (which uses a similar device) come out warm. This is because of the fuser.

FIGURE 10.14 The fuser



The fuser is made up of three main parts: a halogen heating lamp, a Teflon-coated aluminum fusing roller, and a rubberized pressure roller. The fuser uses the halogen lamp to heat the fusing roller to between 329° F (165° C) and 392° F (200° C). As the paper passes between the two rollers, the pressure roller pushes the paper against the fusing roller, which melts the toner into the paper.

The fuser can cause severe burns! Be careful when working with it.

Printer Controller Circuitry

Another component in the laser printer we need to discuss is the *printer controller assembly*. This large circuit board converts signals from the computer into signals for the various assemblies in the laser printer, using a process known as *rasterizing*. This circuit board is usually mounted under the printer. The board has connectors for each type of interface and cables to each assembly.

When a computer prints to a laser printer, it sends a signal through a cable to the printer controller assembly. The controller assembly formats the information into a page's worth of line-by-line commands for the laser scanner. The controller sends commands to each of the components, telling them to wake up and begin the EP print process.

Ozone Filter

Your laser printer uses various high-voltage biases inside the case. As anyone who has been outside during a lightning storm can tell you, high voltages create ozone. Ozone is a chemically reactive gas that is created by the high-voltage coronas (charging and transfer) inside the printer. Because ozone is chemically reactive and can severely reduce the life of laser printer components, many older laser printers contain a filter to remove ozone gas from inside the printer as it is produced. This filter must be removed and cleaned with compressed air periodically (cleaning it whenever the toner cartridge is replaced is usually sufficient). Most newer laser printers don't have ozone filters. This is because these printers don't use transfer corona wires but instead use transfer corona rollers, which dramatically reduce ozone emissions.

Duplexing Assembly

Any laser printer worth its money today can print on both sides of the paper. This is accomplished through the use of a *duplexing assembly*. Usually located inside or on the back of the printer, the assembly is responsible for taking the paper, turning it over, and feeding back into the printer so the second side can be printed.

Electrophotographic (EP) Print Process

The *EP print process* is the process by which an EP laser printer forms images on paper. It consists of six major steps, each for a specific goal. Although many different manufacturers call these steps different things or place them in a different order, the basic process is still the same. Here are the steps in the order you will see them on the exam:

1. Cleaning
2. Charging
3. Writing (exposing)
4. Developing
5. Transferring
6. Fusing

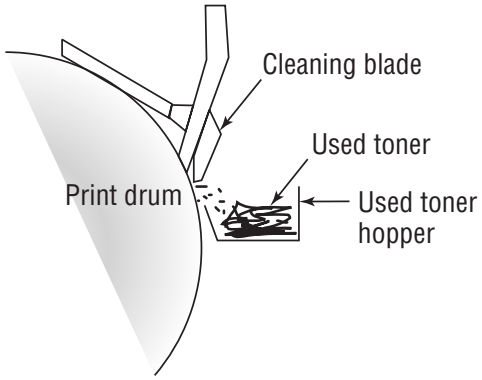
To help you remember the steps of the EP print process in order, learn the first letter of each step: CCWDTF. The most often used mnemonic sentence for this combination of letters is "Charlie Can Walk, Dance, and Talk French."

Before any of these steps can begin, however, the controller must sense that the printer is ready to start printing (toner cartridge installed, fuser warmed to temperature, and all covers in place). Printing cannot take place until the printer is in its ready state, usually indicated by an illuminated Ready LED light or a display that says something like 00 READY (on HP printers). The computer sends the print job to the printer, which begins processing the data. As it's processing the data, the print process steps begin.

Step 1: Cleaning

In the first part of the laser print process, a rubber blade inside the EP cartridge scrapes any toner left on the drum into a used toner receptacle inside the EP cartridge, and a fluorescent lamp discharges any remaining charge on the photosensitive drum (remember that the drum, being photosensitive, loses its charge when exposed to light). This step is called the *cleaning step* (Figure 10.15).

FIGURE 10.15 The cleaning step of the EP process



The EP cartridge is constantly cleaning the drum. It may take more than one rotation of the photosensitive drum to make an image on the paper. The cleaning step keeps the drum fresh for each use. If you didn't clean the drum, you would see ghosts of previous pages printed along with your image.

The amount of toner removed in the cleaning process is quite small. The cartridge will run out of toner before the used toner receptacle fills up.

Step 2: Charging

The next step in the EP process is the *charging step* (Figure 10.16). In this step, a special wire or roller (called a *charging corona*) within the EP toner cartridge (above the photosensitive drum) gets a high voltage from the HVPS. It uses this high voltage to apply a strong, uniform negative charge (around –600VDC) to the surface of the photosensitive drum.

Step 3: Writing

Next is the *writing step*. In this step, the laser is turned on and scans the drum from side to side, flashing on and off according to the bits of information the printer controller sends it as it communicates the individual bits of the image. Wherever the laser beam touches, the photosensitive drum's charge is severely reduced from –600VDC to a slight negative charge (around –100VDC). As the drum rotates, a pattern of exposed areas is formed, representing the image to be printed. Figure 10.17 shows this process.

FIGURE 10.16 The charging step of the EP process

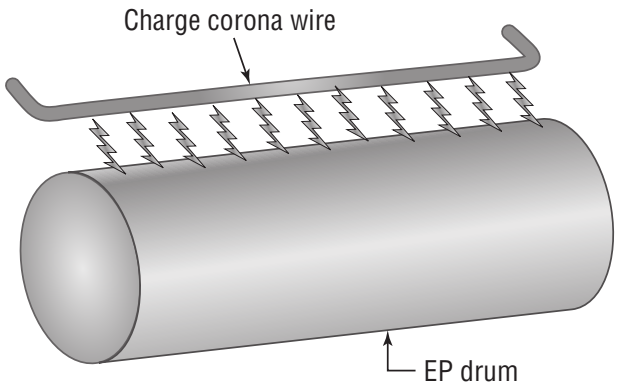
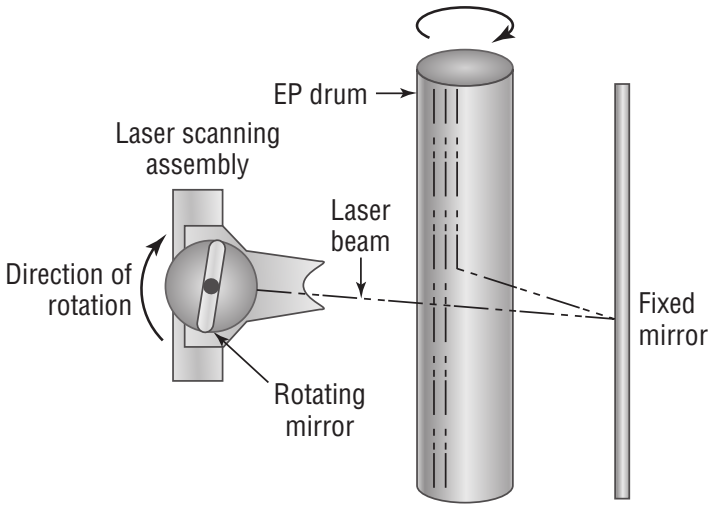


FIGURE 10.17 The writing step of the EP process



You might also hear this step called the exposing step because it's when the drum is exposed to the laser.

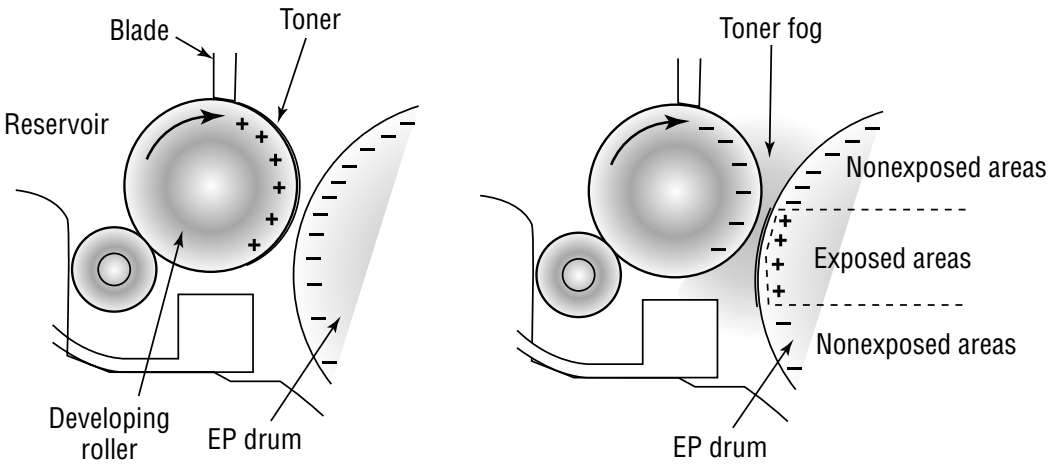
At this point, the controller sends a signal to the pickup roller to feed a piece of paper into the printer, where it stops at the registration rollers.

Step 4: Developing

Now that the surface of the drum holds an electrical representation of the image being printed, its discrete electrical charges need to be converted into something that can be transferred to a piece of paper. The EP process step that accomplishes this is the *developing step* (Figure 10.18). In this step, toner is transferred to the areas that were exposed in the writing step.

A metallic roller called the *developing roller* inside an EP cartridge acquires a –600VDC charge (called a *bias voltage*) from the HVPS. The toner sticks to this roller because there is a magnet located inside the roller and because of the electrostatic charges between the toner and the developing roller. While the developing roller rotates toward the photosensitive drum, the toner acquires the charge of the roller (–600VDC). When the toner comes between the developing roller and the photosensitive drum, the toner is attracted to the areas that have been exposed by the laser (because these areas have a lesser charge, –100VDC). The toner also is repelled from the unexposed areas (because they are at the same –600VDC charge and like charges repel). This toner transfer creates a fog of toner between the EP drum and the developing roller.

FIGURE 10.18 The developing step of the EP process



The photosensitive drum now has toner stuck to it where the laser has written. The photosensitive drum continues to rotate until the developed image is ready to be transferred to paper in the next step.

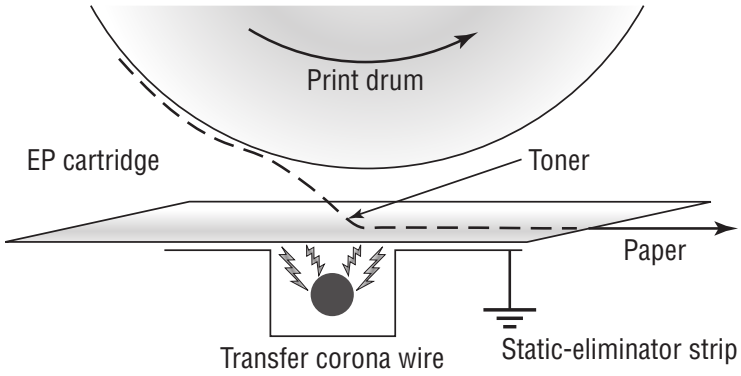
Step 5: Transferring

At this point in the EP process, the developed image is rotating into position. The controller notifies the registration rollers that the paper should be fed through. The registration rollers move the paper underneath the photosensitive drum, and the process of transferring the image can begin; this is the *transferring step*.

The controller sends a signal to the charging corona wire or roller (depending on which one the printer has) and tells it to turn on. The corona wire/roller then acquires a strong *positive* charge (+600VDC) and applies that charge to the paper. The paper, thus charged, pulls the toner from the photosensitive drum at the line of contact between the roller and the paper because the paper and toner have opposite charges. Once the registration rollers move the paper past the corona wire, the static-eliminator strip removes all charge from that line of the paper. Figure 10.19 details this step. If the strip didn't bleed this charge away, the paper would attract itself to the toner cartridge and cause a paper jam.

The toner is now held in place by weak electrostatic charges and gravity. It will not stay there, however, unless it is made permanent, which is the reason for the fusing step.

FIGURE 10.19 The transferring step of the EP process

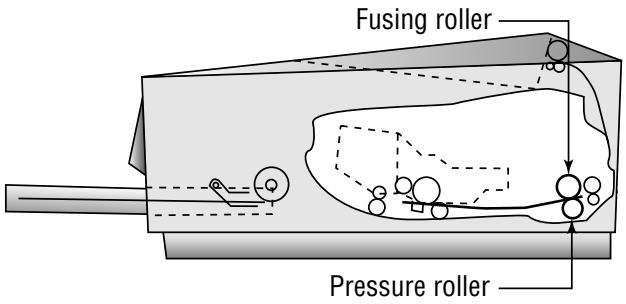


Step 6: Fusing

In the final step, the *fusing step*, the toner image is made permanent. The registration rollers push the paper toward the fuser rollers. Once the fuser grabs the paper, the registration rollers push for only a short time more. The fuser is now in control of moving the paper.

As the paper passes through the fuser, the 350° F fuser roller melts the polyester resin of the toner, and the rubberized pressure roller presses it permanently into the paper (Figure 10.20). The paper continues through the fuser and eventually exits the printer.

FIGURE 10.20 The fusing step of the EP process



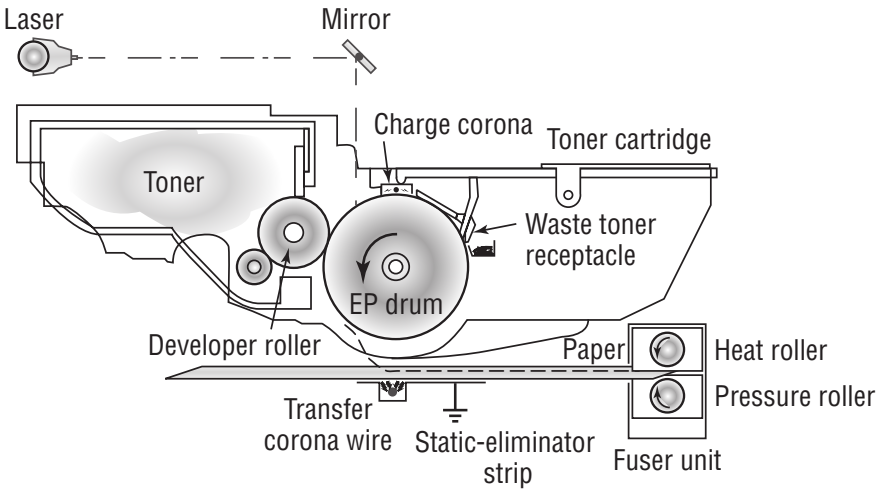
Once the paper completely exits the fuser, it trips a sensor that tells the printer to finish the EP process with the cleaning step. At this point, the printer can print another page, and the EP process can begin again.

Summary of the EP Print Process

Figure 10.21 summarizes all the parts involved in the EP printing process. First, the printer uses a rubber scraper to clean the photosensitive drum. Then the printer places a uniform –600VDC charge on the photosensitive drum by means of a charging corona. The laser "paints" an image onto the photosensitive drum, discharging the image areas

to a much lower voltage (–100VDC). The developing roller in the toner cartridge has charged (–600VDC) toner stuck to it. As it rolls the toner toward the photosensitive drum, the toner is attracted to (and sticks to) the areas of the photosensitive drum that the laser has discharged. The image is then transferred from the drum to the paper at its line of contact by means of the transfer corona wire (or corona roller) with a +600VDC charge. The static-eliminator strip removes the high, positive charge from the paper, and the paper, now holding the image, moves on. The paper then enters the fuser, where a fuser roller and the pressure roller make the image permanent. The paper exits the printer, and the printer begins printing the next page or returns to its ready state.

FIGURE 10.21 The EP print process



Thermal Printers

The types of printers you have learned about so far in this chapter account for 90 percent of all printers that are used with home or office computers and that you will see as a repair technician. The other 10 percent consist of other types of printers that primarily differ by the method they use to put colored material on the paper to represent what is being printed. Examples of these include solid ink, dye sublimation, and thermal printers. Keep in mind that for the most part, these printers operate like other printers in many ways: They all have a paper-feed mechanism (sheet-fed or roll); they all require consumables such as ink or toner and paper; they all use the same interfaces, for the most part, as other types of printers; and they are usually about the same size.

Thermal printing technology is used in many Point of Sale terminals and older fax machines (newer fax machines usually use inkjet or laser technology). They print on a kind of special, waxy paper that comes on a roll; the paper turns black when heat passes over it. *Thermal printers* work by using a print head the width of the paper. When it needs to print, a heating element heats certain spots on the print head. The paper below the heated print head turns black in those spots. As the paper moves through the printer, the pattern of blackened spots forms an image on the page of what is being printed. Another type of thermal printer uses a heat-sensitive ribbon instead of heat-sensitive paper. A thermal print head melts

wax-based ink from the ribbon onto the paper. These are called thermal transfer or thermal wax-transfer printers.

Thermal direct printers typically have long lives because they have few moving parts. The only unique part that you might not be as familiar with is the paper feed assembly, which oftentimes needs to accommodate a roll of paper instead of sheets. The paper is somewhat expensive, doesn't last long (especially if it is left in a very warm place, like a closed car in summer), and produces poorer-quality images than most of the other printing technologies.

Installing and Configuring Printers

Odds are that if someone owns a computer they own a printer as well. If they don't, they have easy access to a printer at a library, work, or some other place. Many retailers and computer manufacturers make it incredibly easy to buy a printer because they often bundle a printer with a computer system as an incentive to get you to buy.

The A+ 220-801 exam will test your knowledge of the procedures to install printers. We're going to break this section into two parts: printer interface components and installing and sharing printers.

Printer Interface Components

A printer's *interface* is the collection of hardware and software that allows the printer to communicate with a computer. The hardware interface is commonly called a port. Each printer has at least one interface, but some printers have several to make them more flexible in a multiplatform environment. If a printer has several interfaces, it can usually switch between them on the fly so that several computers can print at the same time.

An interface incorporates several components, including its interface type and the *interface software*. Each aspect must be matched on both the printer and the computer. For example, if you have an older HP LaserJet 4L, it only has a parallel port. Therefore, you must use a parallel cable as well as the correct software for the platform being used (for example, a Macintosh HP LaserJet 4L driver if you connect it to a Macintosh computer).

Interface Types

When we say *interface types*, we're talking about the ports used in getting the printed information from the computer to the printer. There are two major classifications here: wired and wireless. Wired examples are serial, parallel, USB, and Ethernet. Wireless options include 802.11, Bluetooth, and infrared. You've learned about these connections in earlier chapters, but now you will learn how they apply to printers.

Serial

When computers send data serially, they send it 1 bit at a time, one after another. The bits stand in line like people at a movie theater, waiting to get in. Just as with modems, you must

set the communication parameters (baud, parity, start and stop bits) on both entities—in this case, the computer and its printer(s)—before communication can take place.

It's very rare to find a serial printer in use today due to slow data transmission speed.

Parallel

When a printer uses parallel communication, it is receiving data 8 bits at a time over eight separate wires (one for each bit). Parallel communication was the most popular way of communicating from computer to printer for many years, mainly because it's faster than serial.

A parallel cable consists of a male DB25 connector that connects to the computer and a male 36-pin Centronics connector that connects to the printer. Most of the cables are less than 10′ long. Parallel cables should be IEEE 1284 compliant.

Keep printer cable lengths to less than 10′. Some people try to run printer cables more than 50′. If the length is greater than 10′, communications can become unreliable due to crosstalk.

Universal Serial Bus (USB)

The most popular type of printer interface as this book is being written is the Universal Serial Bus (USB). In fact, it is the most popular interface for just about every peripheral. The convenience for printers is that it has a higher transfer rate than either serial or parallel and it automatically recognizes new devices. And of course, USB is very easy to physically connect.

Ethernet

Many printers sold today have a wired Ethernet interface that allows them to be hooked directly to an Ethernet cable. These printers have an internal network interface card (NIC) and ROM-based software that allow them to communicate on the network with servers and workstations.

As with any other networking device, the type of network interface used on the printer depends on the type of network to which the printer is being attached. It's likely that the only connection type you will run into is RJ-45 for an Ethernet connection.

Wireless

The latest boom in printer interface technology is wireless. Clearly, people love their WiFi because it enables them to roam around an office and still remain connected to one another and to their network. It logically follows that someone came up with the brilliant idea that it would be nice if printers could be that mobile as well—after all, many are on carts with wheels. Some printers have built-in WiFi interfaces, while others can accept wireless network cards.

The wireless technology that is especially popular among peripheral manufacturers is *Bluetooth*. Bluetooth is a short-range wireless technology; most devices are specified to work within 10 meters (33 feet). Printers such as the HP Officejet 100 mobile printer have Bluetooth capability.

When printing with a Bluetooth-enabled device (like a PDA or cell phone) and a Bluetooth-enabled printer, all you need to do is get within range of the device (that is, move closer), select the print driver from the device, and choose Print. The information is transmitted wirelessly through the air using radio waves and is received by the device.

WiFi is used to connect printers to a network, whereas Bluetooth can be used to connect a printer to a single computer (or mobile device).

Infrared

With the explosion of personal digital assistants (PDAs) and other handheld devices, the need grew for printing under the constraints they provide. The biggest hurdle faced by handheld device owners who need to print is the lack of any kind of universal interface. Most interfaces are too big and bulky to be used on handheld computers such as PDAs. The solution was to incorporate the standardized technology used on some remote controls: infrared transmissions. *Infrared transmissions* are simply wireless transmissions that use radiation in the infrared range of the electromagnetic spectrum. Some laser printers come with infrared transmitter/receivers (transceivers) so that they can communicate with the infrared ports on handhelds. This allows the user of a PDA, handheld, or laptop to print to that printer by pointing the device at the printer and initiating the print process.

As far as configuring the interface is concerned, very little needs to be done. The infrared interfaces are generally enabled by default on the computers, handhelds, and printers equipped with them. The only additional item that must be configured is the print driver on the PDA, handheld, or computer. The driver must be the correct one for the printer to which you are printing. In order to make infrared work, you need clear line of sight between the two devices and the devices need to be within about 3 feet of each other.

Interface Software

Now that we've looked at the ways you can connect your printer, it's time to face a grim reality: Computers and printers don't know how to talk to each other. They need help. That help comes in the form of interface software used to translate software commands into commands the printer can understand.

There are two major components of interface software: the page-description language and the driver software. The page-description language (PDL) determines how efficient the printer is at converting the information to be printed into signals the printer can understand. The driver software understands and controls the printer. It is very important that you use the correct interface software for your printer. If you use either the wrong page-description language or the wrong driver software, the printer will print garbage—or possibly nothing at all.

Page-Description Languages

A *page-description language* works just as its name implies: It describes the whole page being printed by sending commands that describe the text as well as the margins and other settings. The controller in the printer interprets these commands and turns them into laser pulses (or pin strikes). There are several printer communication languages in existence, but the three most common ones are PostScript, Printer Command Language (PCL), and Graphics Device Interface (GDI).

The first page-description language was PostScript. Developed by Adobe, it was first used in the Apple LaserWriter printer. It made printing graphics fast and simple. Here's how PostScript works: The PostScript printer driver describes the page in terms of "draw" and "position" commands. The page is divided into a very fine grid (as fine as the resolution of the printer). When you want to print a square, a communication like the following takes place:

```
POSITION 1,42%DRAW 10%POSITION 1,64%DRAW10D% . . .
```

These commands tell the printer to draw a line on the page from line 42 to line 64 (vertically). In other words, a page-description language tells the printer to draw a line on the page, gives it the starting and ending points, and that's that. Rather than send the printer the location of each and every dot in the line and an instruction at each and every location to print that location's individual dot, PostScript can get the line drawn with fewer than five instructions. As you can see, PostScript uses commands that are more or less in English. The commands are interpreted by the processor on the printer's controller and converted into the print-control signals.

PCL was developed by Hewlett-Packard in 1984 and originally intended for use with inkjet printers as a competitor to PostScript. Since then, its role has been expanded to virtually every printer type, and it's a de facto industry standard.

GDI is actually a Windows component and is not specific to printers. Instead, it's a series of components that govern how images are presented to both monitors and printers. GDI printers work by using computer processing power instead of their own. The printed image is rendered to a bitmap on the computer and then sent to the printer. This means that the printer hardware doesn't need to be as powerful, which results in a less expensive printer. Generally speaking, the least expensive laser printers on the market are GDI printers.

Many newer printers can handle both PS and PCL (and GDI) and will automatically translate for you. Therefore, it's less likely that you'll install the "wrong" print driver than it was several years ago.

The main advantage of page-description languages is that they move some of the processing from the computer to the printer. With text-only documents, they offer little benefit. However, with documents that have large amounts of graphics or that use numerous fonts, page-description languages make the processing of those print jobs happen much faster. This makes them an ideal choice for laser printers, although nearly every type of printer uses them.

If you're working with an older laser printer and it's printing garbage, check the driver. It might have the letters *PS* or *PCL* at the end of the name. If a PS driver is installed for a printer that wants PCL (or vice versa), garbage output could be the result.

Real World Scenario

Life Without a Page-Description Language

The most basic page-description language is no page-description language. The computer sends all the instructions the printer needs in a serial stream, like so: Position 1, print nothing; Position 2, strike pins 1 and 3; Position 3, print nothing. This type of description language works great for dot-matrix printers, but it can be inefficient for laser printers. For example, if you wanted to print a page using a standard page-description language and there was only one character on the page, there would be a lot of wasted signal for the "print nothing" commands.

With graphics, the commands to draw a shape on the page are relatively complex. For example, to draw a square, the computer (or printer) has to calculate the size of the square and convert that into lots of "strike pin *x*" (or "turn on laser") and "print nothing" commands. This is where the other types of page-description languages come into the picture.

Driver Software

The *driver* software controls how the printer processes the print job. When you install a printer driver for the printer you are using, it allows the computer to print to that printer correctly (assuming you have the correct interface configured between the computer and printer).

If you're working with a Windows-based operating system, Microsoft refers to the software that is installed on the computer and lets you print as the "printer." The physical device where the paper comes out is referred to as the "print device." Here, when we say "printer," we mean the physical device.

When you need to print, you select the printer driver for your printer from a preconfigured list. The driver you select has been configured for the type, brand, and model of printer as well as the computer port to which it is connected. You can also select which paper tray the printer should use as well as any other features the printer has (if applicable). Also, each printer driver is configured to use a particular page-description language.

If the wrong printer driver is selected, the computer will send commands in the wrong language. If that occurs, the printer will print several pages full of garbage (even if only one page of information was sent). This "garbage" isn't garbage at all but the printer page-description language commands printed literally as text instead of being interpreted as control commands.

Installing and Sharing Printers

Although every device is different, there are certain accepted methods used for installing any device. The following procedure works for installing many kinds of devices:

1. Attach the device using a local or network port and connect the power.
2. Install and update the device driver and calibrate the device.
3. Configure options and settings.
4. Print a test page.
5. Verify compatibility with the operating system and applications.
6. Educate users about basic functionality.

Before installing any device, read your device's installation instructions. There are exceptions to every rule.

Step 1: Attach the Device Using a Local or Network Port and Connect Power

When installing a printer, you must first take the device out of its packaging and set it up on a flat, stable surface. Then, with it powered off, connect the device to either the host computer (if it is a local printer device) or to the network (if it is a network device).

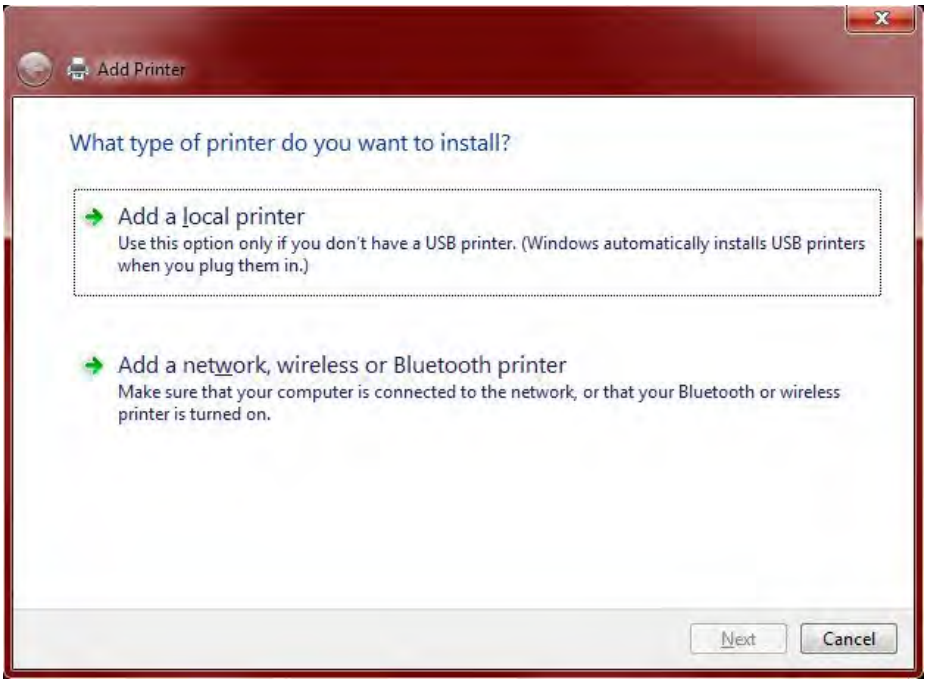
Once you have connected the device, connect power to it using whatever supplied power adapter comes with it. Some devices have their own built-in power supply and just need an AC power cord connecting the device to the wall outlet, while others rely on an external transformer and power supply. Finally, turn on the device.

Step 2: Install and Update the Device Driver and Calibrate the Device

Once you have connected and powered up the device, boot up the computer and wait for Windows to recognize the device. Windows will pop up a screen similar to the one shown in Figure 10.22. This wizard will allow you to configure the driver for the printer (depending on the device). You can insert the driver CD or DVD that comes with the device and the wizard will guide you through the device driver installation. If Windows fails to recognize the device, you can use the Add a Printer (in Windows 7) or the Add Printer Wizard (in older Windows versions) to troubleshoot the installation and to install the device drivers.

This might go without saying at this point, but it bears repeating: You need the right driver, one that matches both your printer and your operating system, for everything to work right.

FIGURE 10.22 Adding a printer in Windows 7



Once the driver is installed, the device will function. But some devices, such as inkjet printers, must be calibrated. *Calibration* is the process by which a device is brought within functional specifications. For example, inkjet printers need their print heads aligned so they print evenly and don't print funny-looking letters and unevenly spaced lines. The process is part of the installation of all inkjet printers.

When working with print media, it is especially important to calibrate all your hardware, including your monitor, scanner, printer, and digital camera, to ensure color matching.

Each manufacturer's process is different, but a typical alignment/calibration works like this:

1. During software installation, the installation wizard asks you if you would like to calibrate now, to which you respond Yes or OK.
2. The printer prints out a sheet with multiple sets of numbered lines. Each set of lines represents an alignment instance.
3. The software will ask you which set(s) looks the best. Enter the number and click OK or Continue.

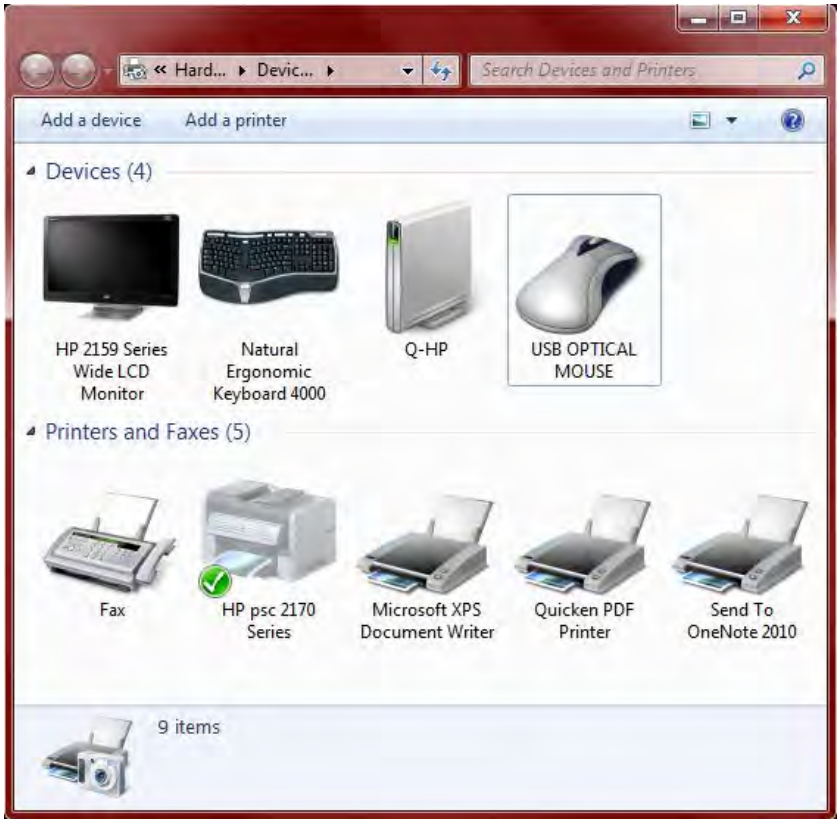
4. Some alignment routines end at this point. Others will reprint the alignment page and see if the alignment "took." If not, you can reenter the number of which one looks the best.
5. Click Finish to end the alignment routine.

Step 3: Configure Options and Settings

Once you have installed the software and calibrated the device, you can configure any options you would like for the printer. All of the settings and how to change them can be found online or in your user manual.

Where you configure specific printer properties depends a lot on the printer itself. As a rule of thumb, you're looking for the Printer Properties or Printing Preferences applet. In Windows 7, if you click Start and then Devices And Printers, you will get a window similar to the one shown in Figure 10.23. At the top there is an option to add a device or a printer. If you double-click the printer icon, you will get another window (like the one in Figure 10.24) that lets you get to the printer's configuration options.

FIGURE 10.23 Devices And Printers



If you don't see the options you're looking for, be sure to highlight the printer first.

FIGURE 10.24 Printer information and options

Various configuration features can be set from each menu option. The first two options in this example are the ones you would probably be the most interested in. The first one, See What's Printing, lets you look at and manage the print queue. This is something we'll talk more about in Chapter 20. The second one, Customize Your Printer, is where you find the printer's properties, shown in Figure 10.25.

From this dialog box, you can configure nearly any option you want to for your printer. The Properties dialog box will be pretty much the same for any printer you install, and we'll cover a few options here in a minute. First though, notice the Preferences button on the General tab. Clicking this will produce a new window like the one in Figure 10.26. That window will have configuration options based on the specific model of printer you're working with.

Now back to the Properties dialog box. The printer's Properties dialog box is less about how the printer does its job and more about how people can access the printer. From the Properties dialog box, you can share the printer, set up the port that it's on, configure when the printer will be available throughout the day, and specify who can use it. Let's take a look at a few key tabs. We've already taken a look at the General tab, which has the Preferences button as well as the all-important Print Test Page button. It's handy for troubleshooting!

FIGURE 10.25 Printer Properties dialog box

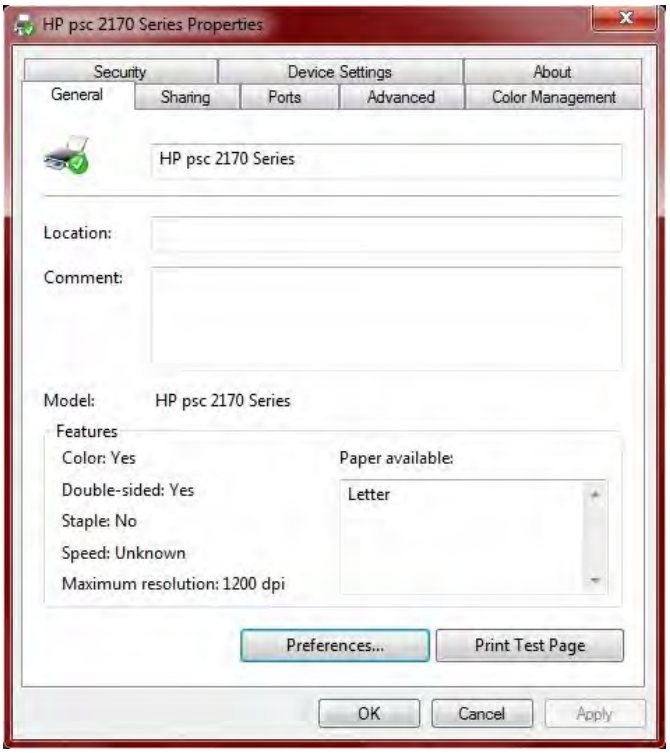


FIGURE 10.26 Printing Preferences window

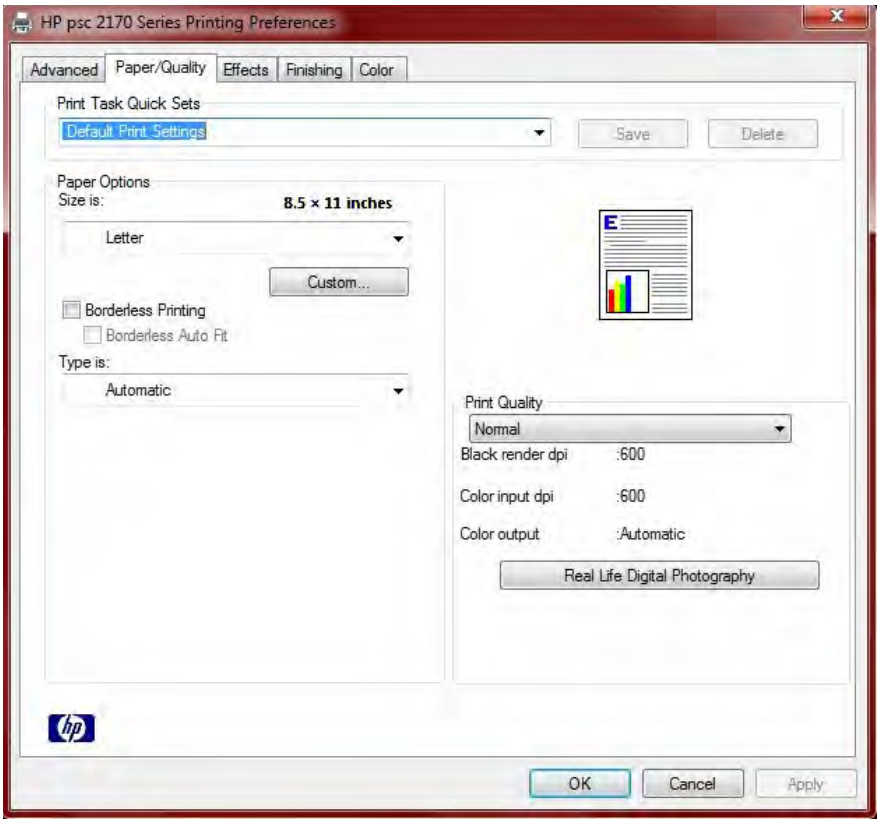
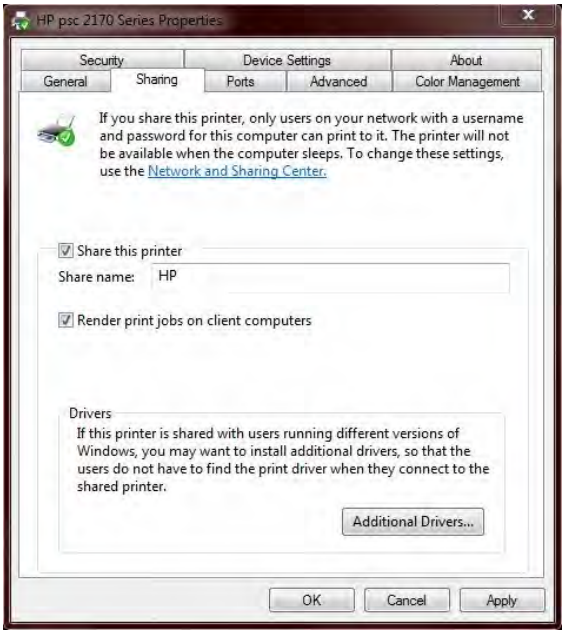


Figure 10.27 shows the Sharing tab. If you want other users to be able to print to this printer, you need to share it. Notice the warnings above the Share This Printer check box. Those are important to remember. When you share the printer, you give it a share name. Network users can map the printer through their own Add Printer Wizard (choosing a networked printer) and by using the standard `\\computer_name\share_name` convention. User permissions are managed through the Security tab.

FIGURE 10.27 Printer Properties Sharing tab



One other important feature to call out on this tab is the Additional Drivers button. This one provides a description that is fairly self-explanatory.

Figure 10.28 shows the Ports tab. Here you can configure your printer port and add and delete ports. There's also a check box here to enable printer pooling. This would be used if you have multiple physical printers that operate under the same printer name.

If you're going to configure a printer pool, remember that all of the output can appear on any of the devices that are part of that pool. Make sure all of the printers in that pool are in the same physical location! Otherwise, you will have people wandering all over the office trying to find their printouts. That might be entertaining for you, but not so much for them.

Figure 10.29 shows the important Advanced tab of the printer Properties dialog box. On this tab, you can configure the printer to be available during only certain hours of the day. This might be useful if you're trying to curtail after-hours printing of non-work-related documents, for example. You can also configure the spool settings. For faster printing, you should always spool the jobs instead of printing directly to the printer. However, if the printer is printing garbage, you can try printing directly to it to see if the spooler is causing the problem.

FIGURE 10.28 Printer Properties Ports tab

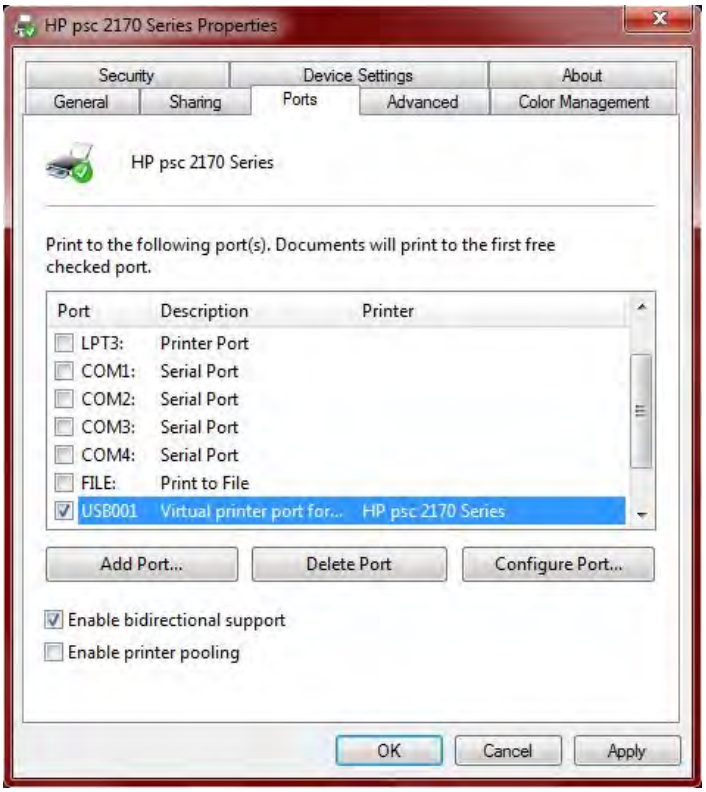
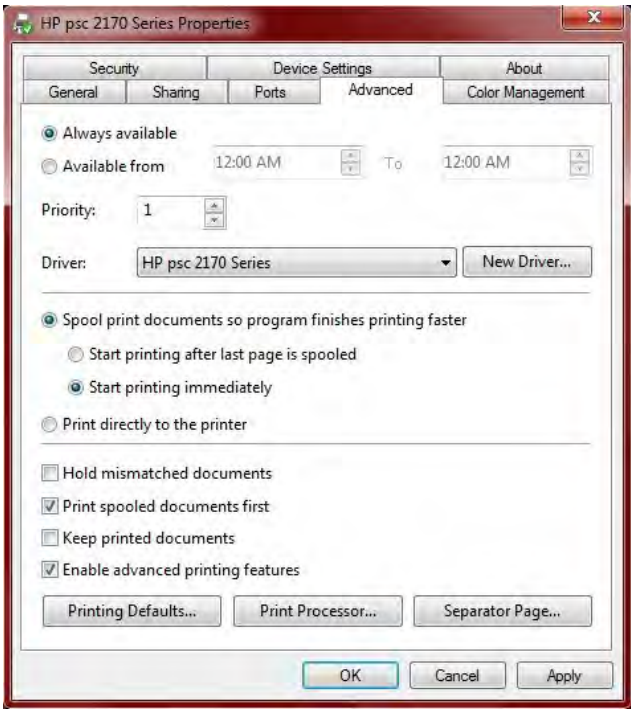


FIGURE 10.29 Printer Properties Advanced tab



Regarding the check boxes at the bottom, you will want to always print spooled documents first because that speeds up the printing process. If you need to maintain an electronic copy of all printed files, check the Keep Printed Documents check box. Keep in mind that this will eat up a lot of hard disk space.

Finally, the Printing Defaults button takes you to the Printing Preferences window (shown earlier in Figure 10.26). Print Processor lets you select alternate methods of processing print jobs (not usually needed), and Separator Page lets you specify a file to use as a separator page (a document that prints out at the beginning of each separate print job, usually with the user's name on it), which can be useful if you have several (or several dozen) users sharing one printer.

Step 4: Print a Test Page

Once you have configured your printer, you are finished and can print a test page to test its output. Windows has a built-in function for doing just that. To print a test page, right-click the icon for the printer you installed from within the Devices And Printers window and click Printer properties. On the General tab of the Printer properties (shown in Figure 10.25), there will be a Print Test Page button. Click that button and Windows will send a test page to the printer. If the page prints, your printer is working. If not, double-check all of your connections. If they appear to be in order, then read ahead to Chapter 20 for troubleshooting tips.

Step 5: Verify Compatibility with Operating System and Applications

Once your printer is installed and you have tried out a test page, everything else should work well, right? That's usually true, but it's good practice to verify compatibility with applications before you consider the device fully installed.

With printers, this process is rather straightforward. Open the application you wonder about and print something. For example, open up Microsoft Word, type in some gibberish (or open a real document if you want), and print it out. If you are running non-Microsoft applications (such as a computer-aided drafting program or accounting software) and have questions about their compatibility with the printer, try printing from those programs as well.

Step 6: Educate Users About Basic Functionality

Most users today know how to print, but not everyone knows how to install the right printer or print efficiently. This can be a significant issue in work environments.

Say your workplace has 10 different printers, and you just installed number 11. First, your company should use a naming process to identify the printers in a way that makes sense. Calling a printer HPLJ4 on a network does little to help users understand where that printer is in the building. After installing the printer, offer installation assistance to those who might want to use the device. Show users how to install the printer in Windows (or if printer installation is automated, let them know they have a new printer and where it is).

Also let the users know the various options available on that printer. Can it print double-sided? If so, you can save a lot of paper. Show users how to configure that. Is it a color printer? Do users really need color for rough drafts of documents or presentations? Show users how to print in black and white on a color printer to save the expensive color ink or toner cartridges.

In Exercise 10.2 we'll step through the process of installing a USB printer in Windows 7; the process will work in Windows XP or Vista as well.

EXERCISE 10.2

Installing a USB printer in Windows 7

For this exercise, you will need the following items:

- A USB printer
- A USB printer cable
- The software driver CD or DVD that came with the printer
- A computer with a free USB port and a CD-ROM drive

1. Turn on the computer.
2. Plug the printer in to the wall outlet and turn it on.
3. Insert the CD into the computer's CD-ROM drive. The driver CD's autorun feature should automatically start the installation program. If not, click Start ➢ Run and type in **`D:\setup`** or **`D:\install`** (if your CD-ROM drive letter is different, substitute that letter for *D*).
4. Follow the prompts in the installation program to install the driver.
5. Once the software has been installed, plug one end of the USB cable into the printer and the other end into the free USB port. Some installation programs will prompt you for this step.
6. Windows will automatically detect the new printer, install the driver, and configure it automatically. Windows will display a balloon in the lower-right corner of the screen saying *Your hardware is now installed and is ready to use*. If Windows doesn't properly detect the printer, open Add a Printer to begin the installation process again, and manually specify the location of the print driver (such as the CD-ROM).
7. Print a test page to see if the printer can communicate and print properly.